THE POPULAR SCIENCE MONTHLY

THE POPULAR SCIENCE MONTHLY

EDITED BY

J. McKEEN CATTELL

VOLUME LXXXVI

JANUARY TO JUNE, 1915

NEW YORK
THE SCIENCE PRESS
1915

PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE POPULAR SCIENCE MONTHLY.

JANUARY, 1915

GEOGRAPHY IN RUSSIAN HISTORY

By WILLIAM E. LINGELBACH

THE history of Russia affords a striking example, not only of the influence of geography on history, but of the fact that man's place in the scale of civilization is in large measure determined by his environment. In speaking of the contrasts in the development of Russia as compared with England, a recent writer says:

> The fundamental difference between Russian and English history is the difference between the great plain and the island. English history tells of the upbuilding by an island people of the greatest maritime empire in the world. Russian history tells how a people . . . gradually, with toil, pain and effort secured possession of the greatest plain in the world and so created the broadest of land empires.

The empire of the plain! The very phrase suggests what Professor Kluchevsky calls the most characteristic feature of Russian history, namely, a spreading out or expansion over contiguous territory, a colonization.

It is not, however, only when comparison is made with England that geography appears so conspicuously as a factor in shaping the fundamental character of Russian development. Thus eastern Europe is organized into one single political unit, while western Europe, that is the smaller half of the continent, is divided into nineteen separate and independent states. The causes are manifest if we glance at the map. The surface of western Europe is broken and diversified, there are plains surrounded by mountains and uplands, there are transverse ranges making climatic divisions, and the sea penetrating deeply into the heart of the continent serves further to create physical or geographic units which invite the growth of separate states in response to boundaries set by mountain and sea. In eastern Europe, on the other hand, a great level plain spreads itself over an immense area. There are no divisions

and no barriers and as a consequence no separate states over all of this great region.

The size of the Russian empire is therefore tremendous. European Russia is in itself larger than the other nineteen states of the continent taken together, and when we include Asiatic Russia, western Europe shrinks into insignificance. The Russian empire comprises one sixth of the total land area of the world; it is four times the size of the continent of Europe, forty-two times the size of France, nearly three times the size of the United States without Alaska, and seventy times the size of the British Isles. An English sailor knowing little about geography, and not yet caught by the propaganda of the English press in favor of things Russian once declared the "Rooshan" was everywhere. "I met him in the Baltic, then I sailed around the whole of Europe and found him on the Black Sea, and after six months around the Cape to India and China, I met him again on the Pacific." There are one hundred and seventy-five million Russians, and yet Russia is the most thinly populated of the great nations. "When you get to my country," said a young Russian nobleman from Bessarabia to me as we neared Libau on the steamer, "You will see how Russia is big, very big!"

Despite its immense extent, however, the land under the scepter of the Tsar constitutes a geographic unit. Even geologically it possesses a degree of uniformity found nowhere else over so large an area. From the Arctic to the Black Sea and from Poland to the Urals, and even farther Siberia, the strata are horizontal. The last of European land to emerge from the glacial drift, it has not been lifted, broken or forced out of place by the great upheavals which caused the diversified surface of western Europe.

Even as to its boundaries or frontiers, it is exceptionally clearly defined and the political state conforms on nearly all sides to the natural or physical. I say nearly, because towards Austria the Carpathians constitute a natural boundary which the Russian state has not yet reached, and which Petersburg confidently hopes to attain through the present war. Then too there are no geographic limits at two important points. Reference to the map shows that there is no physical boundary on the middle west where Russia merges into the German plain. Although nature forgot to form a natural frontier in this region, the ethnic factor entered in and the presence of the Teuton, for the time being at least, staked out a frontier against the Slav. But as usually happens when the ethnic frontier is unsupported by an adequate geographic boundary, confusion and friction arose. Even in times of peace the mothers of East Prussia are wont to silence their children with the ominous warning "Hush, the Rus is coming!" In Poland the absence of a natural boundary is dramatically reflected in political history, not only in the sad tragedy of the destruction of that kingdom in the eigh-

teenth and nineteenth centuries, but in the frequent struggles for the mastery of the borderland, so poignantly driven home, even to us at this distance, by the conflict now waging on the banks of the Vistula.

The other point where the natural frontiers are absent is in the southwest, towards the Danube. There the fact that the Carpathians do not reach to the Black Sea but double back on themselves, leaves an open and inviting road to the rich lands of the lower Danube, while the Black Sea itself offers an even more attractive outlet by way of the Bosphorus and Constantinople as the gateway to the Mediterranean and one of the world's great trade routes. And how many diplomatic intrigues, wars, conventions and treaties have had their origin in this simple geographic condition.

According to the latest investigations by Russian historians, the Slavic race was, about the second century after Christ, swept by the surging currents of racial migration into the region of the lower and middle Danube. But they were not allowed to remain, for it was they who received that terrible thrashing by Trajan's Romans. As a result of this, a large portion of them turned back, retraced their steps across the Carpathians into the Russian plain, and there on the banks of the lower Dnieper at Kiev slowly organized into a state. Indeed it is this little principality at Kiev that marks the beginning of the Russian nation. Its growth was stimulated by two great historic events. The first was the coming of the Scandinavians under Rurik and the subsequent assimilation, infusing into the Slav, especially the upper or commercial class, some of the military spirit of the north. The second was the adoption of Christianity about the year 1000. The conversion of the Eastern Slav was a step of momentous importance, for it brought a new force into his life. It also articulated, at least partially, his religion with that of western Europe. Partially, for as might be expected, the influence of geography told here, and the proximity of Kiev to Constantinople led the Russians to adopt the Eastern or Greek form of Christianity instead of the Western or Roman. Indeed the adoption at this psychological moment of the Byzantine religion and the Slavonic liturgy may well be regarded as the most fateful moment in Russian history. Later the marriage of Ivan III. with Sophia, the niece and heir of the last of the Constantines, gave to Russia not only the emblem of Byzantium, the double-headed eagle, but a claim to Constantinople itself.

The glories of the early civilization of Russia at Kiev, which even chroniclers of the west say outshone that of Alfred or of Charles the Great, can not delay us here. About the middle of the twelfth century, it was, however, violently interrupted by a great invasion by the Tartar hordes from Asia. The "Man of Rus," the Russian, was conquered and his civilization submerged. Kiev was abandoned in 1240 and those who

could retreated, "trekked," northward into the region of the Volga and the Oká. There, in central Russia, this enforced colonization or "trekking" resulted in the development of the Great Russian stock, which to-day occupies the heart of Russia and constitutes two thirds of the Russian race. Sheltered in the almost impassable forests of central Russia, the Russian retained his nationality, and slowly recovering his strength, not only threw off the Tartar yoke but also freed his kinsmen on the Dnieper. In the subsequent centuries he fought his way to the sea.

The story of the rise of Moscow as the center from which the new Russia slowly expanded till it occupied the great plain of eastern Europe and northern Asia is well known. Midway between the Russian on the Volga and the Russian on the Dnieper rose Moscow, at the meeting place of the three great roads of the region. Its beginning must have been very humble for a rhymning tale of a little later period marvels much at its rise,

> What man ever thought or divined that Moscow could be accounted an Empire? Once by the river Moskva there stood only the goodly hamlets of the boyar, of the worthy Stephen Kutchak the son of Ivan.

Under Ivan the Terrible in the sixteenth century, the mighty Volga, "Mother Volga," was conquered and its cities Kazan and Astrakhan brought under Muscovite rule. Then towards the end of the sixteenth century, the conquest of the land to the east was begun. On New Year's Day of 1581, Yermak, the trapper and giant pirate of the Volga, having been entrusted with a commission by the Tsar, set out to subdue the tribes of Sibir, whence the name Siberia, and the lands of the rich fur trade. A century later the Pacific was reached and northern Asia was added to the Tsar's dominions during the very period that marks the great colonial expansion of France and England.

With the accession of Peter the Great, an era of conquest began which gave the Russian his opportunity to expand over the plain westward. Geographically, as we have seen, it formed a part of the Muscovite territory but hostile races were in possession. During the reign of Peter the Great and later Catherine II., we see the conflict of the rival races for control of all the western provinces of present-day Russia. The victory was with the stronger ethnic group. Peter the Great got the Baltic provinces, pushing the frontier to its natural line, the sea, and in the founding of Petersburg placed "a window," as he put it, for Russia to look out upon Europe; a century later Catherine got a large portion of Poland, adding "the doormat" also. This completed the Russian advance into Europe in this direction save for the acquisition of Finland in 1809 and a further portion of Polish land including the city of Warsaw in 1815.

But the difficulties in the way of expansion to the geographic fron-

tiers encountered in Europe were either not present at all in Asia or else were too weak to offer substantial resistance. Hence Russia has in the last 100 years pushed out to the confines of India and China and added millions of square miles to her territory beyond the Caspian and in southern Siberia. In one place, she has even gone beyond what would appear as the normal physical boundary: in the conquest of the trans-Caucasus she has begun a march that points to the Persian Gulf as her ultimate goal.

Turning now to the more intimate relation of the great Russian plain to the people who have made it their own, a number of striking facts appear. In the first place, it has produced and preserved for the whole vast central area a common physical type, a common religion and a common language. The 125 million Russians occupying this central territory of the Russian plain, as has been often pointed out, show a truly astounding uniformity of head formation when one takes into consideration the size of the territory and the number of people involved. The variation in cephalic index, according to ethnologists, is only about 5 points around 82. That is to say, the Russian not only belongs to the round-headed type, but the ratio between the length and the width of head among the 125 millions varies astonishingly little when compared with the variation in the cephalic index in races whose habits and environment show greater variety. Among the Italians, for example, it is as high as 14 instead of 5 as in Russia, and in France it is 10. Yet both the territory and the number of people involved in each case is very much smaller. A further point of some interest is the fact that Slavic skulls thirteen centuries old, found in this region, exhibit the same peculiarity. Evidently the absorption of the Varangians, and later, of the Turco-Finnish tribes of the region, has in no way affected the head formation. The power of the great plain is dominant and the uniformity and monotony of the land reflects itself in an unparalleled extension over a vast area of a uniform type of head formation.

It would be a mistake, however, to leave the impression that, since a common head formation prevails among the Russians, they are alike in other respects. Quite apart from the many alien races on the frontier, there are three main groups among the Russians themselves, differing from one another not only in dialects, habits and disposition, but physically as well.

First there are the Great Russians numbering over 82,000,000 and much the largest of the three groups. They occupy the heart of Russia with Moscow as the center. Second is the Little Russian, about 37,000,000 strong. He holds the territory south and southwest, including the Don Cossacks, and his center is at the old and first capital of the Russians, on the Dnieper at Kiev. Third is the White Russian, about 5,000,000 in number, in lands east of Poland and northward around Lithua-

nia. The land of the White Russian is heavily wooded and in parts marshy, the soil like that of the Baltic provinces being poor and unproductive. The territory of the Little Russian, on the other hand, is flat and open, comprising the rich black earth belt and the vast grazing steppes of the south. The home of the Great Russian extends from White Russia eastward to the Volga and from Little Russia northward towards the Arctic.

The distinction between these groups is not fanciful but very real. The language spoken by the three groups, though basically the same, differs so much that they can not understand each other. One may be quite conversant with Muscovite and yet be unable to understand the Russian of the Ukraine. Indeed on the border territory between Great and Little Russia villages are found where the two peoples have lived side by side for generations without mixing and without understanding each other's speech. The two groups also differ markedly in appearance. The Great Russian is blonde with chestnut or auburn hair, light complexion and beer colored eyes. In disposition he is phlegmatic, stolid and stubborn. The Little Russian, on the other hand, though possessing the head type of the eastern Slav, as I have already indicated, is dark, even swarthy, with brown eyes and dark brown hair. A further difference appears in his stature, for the Little Russian, despite his name, is big, considerably taller on the average than his brother the Great Russian. The reason for this is not easy to find, unless the greater stature of the Little Russian is but another reflection of the influence of environment. The Little Russian occupies the best land of Russia, the fertile soil of the black earth belt, and the consequent better nourishment extending over a long period of time together with some admixture of old Polish stock is doubtless responsible for his larger stature.

But it is not merely physically that the Little Russian differs from the Great Russian. He differs from him quite as much in disposition and habits of life. He is more mellow and open hearted; the sun of the southland has made him kind, hospitable and emotional. He is musical, highly imaginative and poetical, fond of pleasure, games and dancing. To him Russia owes most of her music, her poetry and her folk song. "What ecstasy, what joy has a summer day in Little Russia," cries Gogol, in the bleak and uncongenial Petersburg, as he writes his "Evenings on a Farm in the Ukraine." Indeed this gifted son of Little Russia, whose sketches reflect so many of the characteristics of his native land, denied to the Great Russian with his roughness, surliness and phlegmatic character, any share or claim in the Slavonic race. With the White Russian we can not linger; he is regarded by some as nearest the original type of the eastern Slav. His name is probably a result of the color of his clothes—a light-colored homespun devoid

as well of the somber hues of the Great Russian's attire, as of the brightness and variegated colors of the Little Russian.

But despite these differences, the great plain dominates, and environment added to common history and a common religion, has produced a people of greater homogeneity than is known anywhere else on so large a scale.

Among the races of the frontier, the differences are more striking, not only between group and group but between each group and the Russian proper. They occupy the territory on the outer border; Poland, the Baltic provinces, Finland, the foothills of the Urals, the lower Volga, and the region of the Caucasus, and furnish almost every variety of head formation, stature, color scheme and what goes without saying, a veritable Babel of languages or dialects. The Russian Year Book for 1912 notes 101 languages or dialects, and there is excellent authority for the statement that at Tiflis 68 of these are in actual use.

First among the non-Russian peoples of the fringe are the Poles. There are between seven and eight million Poles under Russian rule, and at Warsaw one of the most tragic racial struggles of history has been in progress for well-nigh a century and a half. The Poles are Slavs but belong to the western branch of the race and are ardently devoted to the Roman Catholic instead of the Greek Catholic Church. Generally speaking the ethnic type more nearly resembles the Little Russian, both in appearance and character. But the effect of prolonged oppression involving the elimination of a large proportion of the best manhood is having its effects. This fact impresses itself more emphatically on the casual visitor because of the presence in Poland of millions of unfortunate Jews, forced into the country by the policy of Russian autocracy and necessarily living under conditions of the most cruel and grinding poverty.

To the north of the Poles and occupying the Baltic provinces, a region of birch and pine with a poor soil, are two peoples, the Letts and the Germans. The Letts with their chief center at Vilna constitute the lower class. They are at the same time the oldest remnant of the Aryan stock. There are between three and four millions of them; all belong to the peasant class and are a raw-boned race, simple in language, taste and habits. They were the last of the Aryan peoples to accept Christianity and their language is of interest because it is the most ancient form of Aryan extant. As might be expected it has scarcely any words to express abstract ideas, its vocabulary being confined to words for concrete objects. The upper class in the Baltic provinces is German. There are not a great many of them, but they are the great landed proprietors, business and commercial men. The chief cities are Riga and Libau. Riga in particular boasts of a history as-

sociated with the glories of the Hanseatic League, and to this day it impresses one as distinctly German in appearance.

Further to the north still, along the shores of the Gulf of Finland are the Finns, subjects of Sweden for many years, but conquered by Russia in 1809. Their culture is distinctly Teutonic and on coming from Russia to Finland one is at once struck by the absence of the Russian or Byzantine architecture in the churches; similarly the ubiquitous uniform of Petersburg is also absent. Altogether it is a world non-Russian, despite the fact that it has formed a part of the Russian empire for 105 years. The Finns are a non-European stock, Mongolian in origin, and physically differ considerably from the Russians. They are taller and belong to the long-headed type and the eyes are almost uniformly blue. They have had a constant struggle with a poor soil, an adverse climate and an overpowerful neighbor. Yet in Finland all can read, and very few are to be found who can not write also. One can not but be impressed with the industry and pluck of this valiant little people, and feel in sympathy with the Finnish economists who see in the geographic location and the magnificent water power of their country the basis for a great development in the future.

The Finns appear further as the principal people over the entire area of northern Russia, excepting the stunted and wandering Lapps with their reindeer, and the Samoyads—a heathen fisher folk of the northeast. Indeed this region was theirs till the Great Russian conquered it. Petersburg itself is set down in the midst of a Finnish country; a land of marsh and forest occupied by Finnish peasants, Teutonic in culture. Indeed from the ethnic standpoint the old name of the Russian capital is more in accord with historic and even actual conditions than its present one of Petrograd, which is of course the Russian instead of German for the city of Peter. The conquest of northern Russia by the Muscovites did not bring with it any war of annihilation or wholesale migration. Slav and Finn have existed side by side for generations, the latter being subjected to a gradual process of absorption by the Great Russian. The Finns in their little villages hold out stubbornly against it, women being particularly tenacious in retaining the old customs.

MacKenzie Wallace says,

> On the other hand, like women in general when they do begin to change, they change more rapidly. The men adopt the Russian costume gradually; women adopt it at once. As soon as a single woman gets a gaudy dress every other woman in the village feels envious and impatient till she has one likewise.

He tells of having tried in vain to buy a female tribal costume in several villages and finally going on to another expecting the same difficulty. Accordingly he had his inn-keeper make known his quest and the very liberal terms he was ready to offer. This time the result was startingly different. To give his own words:

In a few minutes . . . the house in which I was sitting was besieged by a great crowd of women holding in their hands articles of Finnish wearing apparel. In order to make a selection I went out into the crowd, but the desire to find a purchaser was so general and so ardent that I was regularly mobbed. The women shouting "Kupi, Kupi"—("Buy, Buy!")

The fact that toward the east the Russian has pushed across Asia to the Pacific does not mean that he has absorbed and Russianized what lies between. Indeed from Nijni-Novgorod where the Volga turns southward, that river, to the elbow at Tsaritsin, constitutes, in a sense, an ethnic boundary. Here non-slavic races—fag-ends of peoples—are found, preserving not only their own speech and habits but costumes as well. As a result a voyage on the Volga affords unique and fascinating points of interest, quite apart from its scenic and geographic features. A bewildering confusion of racial types appear. Asia and Europe seem to meet and intermingle, but not to coalesce. The focal point is at Kazan where the intermingling of strains of blood, of religions, of customs and of languages, is at its maximum. It is Russia's "melting pot." But thus far the heat has not been sufficient to effect a coalescence of the many racial ingredients it contains.

Turning from the discussion of the ethnic elements of European Russia to the conditions of life prevalent among them, geographic influences and environment appear in an equally striking manner as dominating factors; and nowhere more than in the ignorance and poverty so general among the great mass of the Russians. We are told that the mothers of Vladimir's day bewailed as dead the little ones taken from them to be taught the alphabet. To-day over seventy-five per cent. of the population is illiterate. Nor is this at all surprising. Only a hundred years ago, Russians were sold in the open market at Moscow. "To be sold: three coachmen, well-trained and handsome:—two girls, the one eighteen, and the other fifteen years of age, both of them good looking," etc., is one of many advertisements of the kind in the Moscow *Gazette* early in the nineteenth century. Serfs and cattle were intentionally put in the same category, as appears in such announcements as "In this house one can buy a coachman and a Dutch cow."

Not until 1861, the year made memorable in the United States by the beginning of the great war that liberated the negro, was the barter in Russian souls stopped by the emancipation edict of Alexander II. This barter appeared not only in the actual exchange of Russian subjects between one landlord and the other, but also in the unpardonable control exercised by the proprietor over the moral welfare of his serfs. The story told by Prince Kropotkin is familiar to many:

One landowner remarked to another, "Why is it that the number of souls on your estate increase so slowly? You probably do not look after their marriages." Thereupon the other went home and ordered a list of all the inhabitants of his village to be brought to him. He picked out from it the names of

the boys who had attained the age of eighteen and the girls just past sixteen,—those are the legal ages for marriage in Russia. Then he wrote, ''John to marry Anna, Paul to marry Parashka,'' and so on with five couples, ''The five weddings'' he added, ''must take place in ten days, next Sunday but one.''

Many will remember Pushkin's exclamation as he listened with growing seriousness to Gogol's reading of "Dead Souls," "God! what a sad country is Russia!" or his comment later, "Gogol invented nothing, he tells the simple truth, the terrible truth."

First among the geographic influences underlying such conditions has undoubtedly been the remoteness of Russia from the main currents of European civilization on the one hand and her close proximity to, and contact with Asia on the other. When the Russian state revived in the fifteenth century around Moscow, it was not only isolated, but overshadowed and stifled by Asia. Evidences of this may be seen in many ways; one still hears the saying, "Scratch a Russian and find a Tartar." The art and architecture of Russia show unmistakable proofs of the necessity the nation was under so many years of bearing the brunt of the Asiatic onslaught. The contact with western civilization, on the other hand, was for a long period remote and attenuated, and the influence of the west upon the Russian masses imperceptible.

Another great difficulty arose from the fact that Russia did not lie on the way to any other part of the world. She has not been on any of the great trade routes or channels of human intercourse. To better understand the significance of this simple geographic fact, we have only to consider its influence in other parts of the world, as for example in the case of the prosperity and progress of the towns along the medieval trade routes, or the conspicuous decline of Renaissance Italy after the discovery of the western hemisphere. Following upon the voyages of Columbus, Vasco da Gama and Magellan, the trade routes left the Mediterranean for the Atlantic and coincident with this came the decay of the Florence of the Medici and the Rome of Julius II. On the other hand, the increased importance of Italy, and for that matter the Balkans, since the opening of the Suez Canal, reflects the return in part at least of the Mediterranean to its former place.

As if to emphasize the geographic isolation still further, infant Russia, following the suggestion of geographic propinquity, went to Byzantium for its religion. This fact was fraught with tremendous consequence, for to her geographic isolation Russia thus added religious isolation. She divorced herself from the religion, thought and culture created in western Europe by the medieval church. She did not share in the civilization in which the church and later the protestant revolt served as basic factors. Political and social institutions developed in ecclesiastical moulds. The very physiognomy of the cities was determined by it, so that even with the development of modern industrialism,

Moscow, Kiev, Petersburg and other places still have the appearance of ecclesiastical cities.

But there is another important factor underlying the slow development of Russia. It is the tremendous size of the Russian plain when considered in connection with the sparseness of the population. The average density of population for the Russian Empire is about 8 persons per square verst. In comparison with western Europe it is 20 times less than in England, 15 times less than in Germany and 10 times less than in France. This adds local isolation to national isolation for even to-day only about 14 per cent. of the population live in towns or near enough to be seriously influenced by the civilizing agencies of modern city life. At least four fifths of Russia is untouched by those powerful engines for progress in the western world, the public press and education. What this means especially during the long Russian winter with its enforced change of employment and relaxation of effort is manifest. There is sound geographic basis for the joy so constantly found in Russian literature at the return of spring after the prolonged winter:

> Spring, beautiful Spring! Come O Spring with joy!
> With great goodness, With tall flax,
> With deep roots, With abundant corn.

These lines have an element of strength that is born of the soil. Indeed they recall the fact that the immense size of the Russian plain reveals its influence in quite another and subtler way; in a certain largeness of character and outlook that can not be judged by the standard test of illiteracy. One feels it in one's associations, not only with the educated but with the people at large. Nor need one go to Russia for this; no one can read the Russian novel and not be impressed by a quality that is the very essence of the country's immensity. Gogol's Homeric romance of Russian history, "Taras Bulba," is crammed with it. It is a story of the old Cossacks in all their barbarous love of fighting, eating and drinking, their giant physical strength and vitality, their intense patriotism, and as W. L. Phelps puts it,

> their blazing devotion to their religious faith. . . . These Cossacks are veritable children of the steppes, and their vast passions, their Homeric laughter, their absolute recklessness in battle, are simply an expression of the boundless range of the mighty landscape.

Turgeniev's "Sketches of a Huntsman" though in a setting nearer Moscow and therefore totally different, has it just as does "War and Peace" by the greatest of all Russians, Leo Tolstoi. There is plenty of local color, of boundless steppes and forest, broad rivers, illimitable snow and long winter nights, but it all has an atmosphere of vastness that is wide as the world in its reach. The characters are cast in a large mould and the problems, though national in setting, are worldwide in their appeal. There is in Tolstoi a quality that is bred of the vicissi-

tudes of life on the Russian plain, of its contact with nature, its aloofness from artificiality, and its call upon the people for suffering and passive resistance.

Though again and again led by autocracy into wars of aggression, the Russians have shown an inaptitude for positive aggressive strategy. They have lacked the *punch*. Apparently invincible, as Napoleon, Frederick the Great and Charles XII. discovered, when resisting attack, they have so far failed in the offensive. Whether this is due to inferior military organization or to a national characteristic induced by environment, and described by Turgeniev, as a weakness of the will among individuals, is hard to determine. Both factors doubtless play their part. It took over an hour to add an extra coach to the night express on which I was traveling from Moscow to Nijni last July, and then a score of people were without accommodation and had to wait till the following day. And that was at Moscow, the principal railroad center of the country.

Another important fact in Russian development has been the predominance of agriculture over every other occupation. There has not been sufficient seaboard for a great commerce, and as yet, industrial development though fraught with great promise, is for the same reason in its beginnings. Of the 175,000,000 Russians, 125,000,000 are engaged in agriculture. A population of peasants! Indeed one is tempted to say an empire of peasants. The soil of the country as well as the climate varies so greatly that almost anything can be raised in Russia from the furs of the government of Archangel to the teas of the Crimea and the cotton of the Trans-Caucasus. In Russia's report for the Glasgow Exposition some years ago occurs the sentence:

> We possess a whole assortment of climates, ranging from that of the Polar regions, which is suitable to fur farming, to the sub-tropical in which may be cultivated for commercial purposes such plants as mandarines, tea and bamboo.

Across the northern portion of the country tundra prevails, but it is not for that reason worthless, for it contains some of the most valuable peat bogs in Europe, second only to those of the central provinces. South of the tundra lies a broad forest belt of pine and birch, with clearings on which flax, rye and oats are grown. Further south still is oak, beech and lime with large clearings for wheat and hemp. Next to this forest zone with its untold wealth in timber is the wide strip of rich vegetable soil which has given to the region the name of the Black Earth Belt. It stretches from the Carpathians to the Urals and even beyond into Asia. The area is covered with a rich deposit of black soil, varying in depth from 12 inches to 12 feet, which rivals the black loam of the Mississippi in its natural fertility, despite the fact that it has produced its crops since the days of Pericles. It awaits only the introduction of more intensive farming and up-to-date machinery to increase its productivity still more.

To the south of the Black Earth Belt lie rich grazing lands affording pasturage for millions of sheep, horses and cattle. In Bessarabia, on the shores of the Black Sea and the Crimea, are vineyards and fruit farms of great beauty and value. But even this by no means exhausts the unparalleled resources of even European Russia. The great variety of minerals in the Urals, the vast deposits of iron and coal in Poland, the coal and graphite of the Donetz Valley, I can only mention in passing. In the region between the Don and the Caspian Sea is the great saline desert, with its inexhaustible supply of salt and fertilizer. According to recent experiments, the soil can be easily adapted to the growth of the sugar beet. Further to the south are the rich oil beds. The output of petroleum in 1912 for the Baku region alone was 420,000,000 poods from over 4,000 wells, and the importance of this in the economic development of the country is inestimable. All Volga steamers now use mazout or crude oil as fuel.

These economic and geographic areas of Russia are in no case separated by physical barriers as is our Pacific slope from the states east of the Rocky Mountains, or even the Atlantic seaboard from the territory beyond the Alleghenies. Russia is without high relief; the watersheds are almost imperceptible elevations. Indeed European Russia is so flat that the Baltic-Black Sea Canal is to be made available for large ocean going vessels by the construction of only two locks. Naturally therefore the rivers and waterways of Russia have been of unusual importance, especially before the days of the railroad, in binding the different economic areas together, affording magnificent arteries for the movement of internal trade both in winter and summer. The rivers are large and sluggish, owing to their great length and slight fall. The Volga is the longest river in Europe. It is 2,300 miles in length, that is, three times as long as the Rhine, yet its total fall is only a little over 800 feet. The peat bogs in the Valdai Hills where it takes its rise are only 750 feet above sea level, while Astrakhan at the mouth is 65 feet below the level of the sea. The Russian fondly speaks and sings of it as "Matushka Volga" or "Little Mother Volga" in gratitude no doubt for the bounteous supply of fish, caviar and game, as well as comforts and pleasures afforded by this historic stream which plays so important a part in the economic life of the nation. The products of Asia and of Europe are carried on its waters; the 2,000 odd river steamers are always busy, and the huge rafts consisting often of thousands of logs, being floated or pulled down the stream, represent a small portion of the riches of Russia's inexhaustible forest lands.

Equally conspicuous at almost every part of the river are the scenes connected with the fishing industry, ranging from the small boy and the old man with the primitive rod and bait at the landing place, to the groups of queer boats with long nets which dot the bosom of the stream

from Tver to Astrakhan. Scientific laboratories maintained by the government for the study of the zoological and biological life of the river have been established at the principal fishing centers. Even in winter fishing is kept up. The fish bury their heads in the mud, their bodies rising upwards in the water. Holes are cut in the ice and the fish are speared, a catch averaging from 6 to 12 fish per spear. The caviar, of which there is the red and black variety, also comes chiefly from this region. The roe is separated from the tissue, beaten through a sieve, and salted for export or home consumption.

In its lower course the Volga enters the great depression once covered by the waters of the Caspian sea. It flows sluggishly past Tsaritsin through the great saline basin and finally loses itself in the Caspian at Astrakhan. This great inland sea, despite the fact that it is only a relic of its former self, is still the largest inland sea in the world. Notwithstanding the fact that it has no outlet, and receives the inflow of the Volga and the Ural, it is constantly declining in level. It is already over 90 feet below the level of the Black Sea. Nor is this all. Sudden and irregular fluctuations in the level have occurred so frequently in recent years that geographers have the theory that there are volcanic disturbances in the sea bed itself.

But despite the wealth of the Volga, the Baku and other regions, the Black Earth Belt is still much the most important. Upon the success or failure of its crops depends in a large measure the prosperity of the nation. Unfortunately the methods of agriculture, in most cases, are still very primitive, but in this as in other matters of Russian economic history rapid progress is being made and generalizations are dangerous. A visit to the fields of the sickle agriculture shows the small narrow strips of medieval times separated not by fences, wood is too scarce in the steppe region for that, but by a furrow or two left clear. A great many of these side by side give the impression of large, very large, fields of wheat, but the grain on each strip, small though it be, has a different owner. Land tenure in many parts of Russia since the emancipation of the serf by Alexander II. has been communal. The title to all rural land belonging to the peasantry was vested in the village community. Hence the Russian peasant was bound to his village which he could not leave save with the consent of the elders; he could not get his land in his own right and farm it as he would; he could not even get his land together in one piece. Instead it was scattered about in different parts of the communal land making him waste much time going from one strip to another. The village community was the absolute master and in its assembly of elders it allotted the strips of land each member was to have as his for cultivation. The result was inevitable. Not only did indifferent farming follow, but with the increase in the population the land had to be constantly re-divided, the strips becoming always

smaller, for the *mir*, as the village community is called, had no means of expanding and taking in new lands. The picture of the Russian peasantry drawn by Tolstoi, Tchekov and others reveals a pathetic state of suffering, misery and discouragement in the wake of what was planned to be a great economic and social reform. Stagnation in the economic life of the people was thus added to political and intellectual stagnation.

Even to-day millions of the Russian peasants are not only too poor to employ any but the simplest instruments of agriculture, but the smallness of their acres make the machinery we are accustomed to out of the question. On the other hand, there are large estates with the finest modern machinery, while the peasant proprietor is gradually overcoming the difficulty by cooperative buying. Six million households were associated with cooperative associations in 1911, and 310 out of the 370 Zemstvos were last year engaged in the sale of agricultural machinery. Long years of experience in the semi-communal dealings of the "mir" have trained the Russian peasants in the qualities necessary for cooperative enterprise.

In the meantime the Zemstvos and the government technical schools are doing all in their power to develop more scientific agriculture and the prospects are good for a thorough reform in agricultural methods in Russia in the near future. Fortunately, a reform inaugurated by the late premier Stolypin in 1905 and now being slowly forced upon a reluctant and conservative peasantry is working a deep and far reaching agrarian revolution. By the application of the Stolypin measure, the Russian peasant can now withdraw from the village community and obtain the consolidation of his holdings, to which he gets the individual title. The larger consequences, aside from better agriculture, are many. The enterprising and thrifty peasant will get on and prosper, while the shiftless will lose what land he has. There will be created in Russia a new class of small but independent farmers on the one hand, and an agricultural proletariat on the other. That the latter will sooner or later find its way to the cities and supply the much needed labor for the steadily growing industrial Russia is also clear. This however is the very reason for the violent opposition to Stolypin's reform by many leading statesmen and economists, who point with pride to the fact that up to the present Russia has not had a class corresponding to the industrial proletariat of western Europe.

For years the appalling losses through fire in the Russian towns and villages was a matter much commented on, but no effort at prevention was seriously undertaken. Stone is scarce throughout Russia for the geological strata are horizontal, hence the houses, barns and other buildings are of necessity constructed of wood, clay, brick and straw. The rural villages present a jumble of thick thatched roofs as inflammable

in dry weather as tinder. According to the findings of a government commission appointed a few years ago to investigate the subject, the losses to the nation by fire amounted to the total destruction of rural Russia once in fifteen years.. The report was the incentive for a vigorous campaign against the thatched roof, with the result that in many villages one can now see the new roofs of wood or metal side by side with the thatched. They are less picturesque but manifestly better, and the change is going on rapidly.

The villages are usually unattractive. Where possible, they are built on low ground, probably as a protection against the cold. The streets and alleys are not paved and in rainy weather they are deep with mud which makes them not only impassable, but owing to the lack of sanitary precautions, a breeding place for disease, especially for typhoid and diphtheria. The death rate is of course appalling. Indeed the question of public health is sadly neglected. In 1909 there was only one doctor for every 11,000 people in the Empire. In the villages of some pretension, one is apt to find a house a little better than the rest that serves as the inn, hard by is the store where necessities are sold and at the end of the village street, or not infrequently back of the individual cottages, is the bathhouse in which the villagers bathe or steam themselves at least once a week.

The building of the village that one would like to find, and rarely does, is the village school, which is so conspicuous in the rural landscape of America and western Europe. Up to the present the Russian seems to have expended his energy in building churches instead of schools. Wherever you go in the land of the Tsars, the existence of an all powerful dominating church is manifest. The sky line of the great cities is dotted with the brightly gilded domes of cathedrals and monasteries, while the country landscape is likewise enriched and enlivened by the presence of the white sobor of the region. Similarly one encounters in the streets of every large city innumerable shrines. The mass of the population still makes the sign of the cross and utters a prayer when passing a church or shrine. In the hut of the peasant as in the palace of the rich, and on every vessel flying the Russian flag, the holy ikon above the little burning lamp with floating wick is always found.

The Russian church ever since the days of Peter the Great has been a state institution. Its clergy are the servants of the state, and it is therefore very closely identified with the government in its administration and policy. The clergy is sharply divided into two groups, the black and the white or grey. The former are monks; they do not marry and from their ranks come the higher clergy. While in the monasteries they occupy themselves with the complexities of the Slavonic liturgy and service, works of charity, painting of ikons, etc., the demand being

of course enormous. Unfortunately the state described by Turgeniev as "remorseless laziness" is quite as prevalent with the monks as with the peasants.

One of the greatest things the clergy has done for the Russian people is the creation of a wonderful church music. The singing and intoning is all by male voices and in some of the churches, as for example, St. Isaacs at Petersburg, or the Synodal Church at Moscow, surpasses in dignity and grandeur any church music in the world. Nothing, it seems to me, can excel in exquisite beauty the singing of the *gosopodoy lui,* the Russian for "God have Mercy" from the moment the first notes of the boy soprano reach you, through the manifold variations to the final appeal by the full chorus to which the deep rich Russian bass gives a power almost of command. Russian music, whether it be the fine liturgical music of the church, the rhythmic and somewhat monotonous singing of the Volga boatmen, the boisterous Troika song, or an ornate opera like Boris Godunov, is permeated through and through with the spirit of the endless plain and a sense of loneliness that rarely admits of majors. The somber hues of the landscape, the atmosphere of the boundless solitudes, dominate; Russian popular music is all in the minor key.

Whether it be the result of ignorance, isolation or climate, the bane of the Russian peasant is intemperance and the amount of vodka he consumes is appalling. The manufacture and sale of the drink is a government monopoly. There are two grades, the best containing about 40 per cent. alcohol. It is a white liquor with a cognac taste vitiated however by an after taste of crude oil which the wealthy Russian overcomes by adding a little palatable sherry. To such an extent has the drink habit grown that the government's revenue from this source last year reached the enormous sum of 800,000,000 roubles or somewhat over $400,000,000.

So threatening has the drink evil become that strenuous efforts have been undertaken to check it. Since the beginning of the war the Tsar has prohibited the manufacture and sale of vodka entirely. That a deep-seated national custom will not be corrected by an edict is evident. Intelligent efforts are, however, being made to bring about the emancipation of the people in this respect. Whatever the outcome of these efforts, the drunkenness of the Russian masses in the past has been proverbial. With this has gone a brutalizing of human nature; men still beat their wives and children apparently for no other reason than to keep up the ancient tradition.

But in this respect too conditions are changing. Indeed it is becoming a commonplace that even the Great Russian is far from being quite so absolutely the master in his house as he used to be. In place of the old folk-song by the young wife: "What sort of husband are

you to me? You do not pull my hair and you do not strike me," one now hears the complaint of the old-fashioned: "God only knows what is getting into our women these days: You can not lay a finger on them without their shouting and making an ado, saying they will go away and not come back." That the amelioration of the lot of woman in Russia has been so long delayed is a matter of surprise, because if Russian writers are fair to their men, the Russian woman is in every respect more practical, energetic and effective; "the incarnation of singleness of purpose" and possessed of a driving force that is only equalled by the irresolution of the male sex. In Finland she sits in the Diet of the nation, in Poland the women more than the men keep alive the fires of Polish patriotism, and in Russia proper they are an important element in the progressive movement.

For several decades an industrial transformation has been in progress in Russia that has largely changed the character of the chief centers of population. While still predominantly agricultural, Russia is rapidly becoming an industrial state as well. There has been a tremendous growth of manufactures in recent years. Hand in hand with the growth of factories, especially those of the iron and textile industries in the cities, there is also a very extensive system of manufacturing on the large estates where the work is done by peasants. With this has come of late an extensive system of encouragement of domestic manufacture, or cottage industry among the peasantry, still prevalent everywhere throughout the central provinces of European Russia. In the textile industry the hand manufacture often cooperates as a direct auxiliary with the great mills of Moscow and Petersburg. An enlightened effort is also being made to perpetuate native or home industry by patriotic societies; stores and agencies are maintained for the woodwork, bric-a-brac, toys, wicker-work, leather goods, pottery, lace, embroidery, etc., made by the peasants during the long winter.

Perhaps the most important factor in this transformation of Russia is the modernization of the transportation of the country. Unfortunately too much emphasis is laid on military interest as opposed to economic needs in the construction of Russian railroads. The foremost English authority on Russia writing ten years ago said,

> When a great enterprise is projected, the first question is—"How will the new scheme affect the interests of the state?" When the course of a new railway has to be determined, the military authorities are among the first to be consulted, and their opinion has great influence on the ultimate decision. The natural consequence is that the railway-map of Russia presents to the eye of the strategist much that is quite unintelligible to the ordinary observer—a fact that will become apparent even to the uninitiated as soon as a war breaks out in eastern Europe.

At the time of the Crimean War, Russia had 750 miles of railroad; in 1913 the Minister of Ways and Communications gave the total

mileage as 46,839, of which 60 per cent. belongs to the state. Russia stands next to the United States in mileage. And added to this is the enormous extent of her navigable waterways aggregating 102,600 miles. On the whole Russia combines a most marvellous system of transportation, almost bewildering in its variety of medieval and modern traffic methods; caravans, motor-vans, barges, vessels with internal combustion engines and up-to-date steam railroads.

The center of the system is not Petersburg but Moscow, the city also most intimately identified historically with the rise and growth of the nation. There are only two important economic areas of Russia that Petersburg can reach without passing through Moscow, and even these are more closely allied to Moscow than to the northern capital. Geography, and by this I mean location as well as resources, has not only kept Moscow on a level with her rival, but guarantees without gainsay to raise her far above the city of Peter in the future. The ecnonomic progress of the present and even more so of the Russia of to-morrow lies not in the region of Petersburg but in the center and south, that is nearer Moscow. The industrial areas from Poland to the southeast through Tula, Ekaterinoslav to the mines of the lower Don, the largest coal-producing fields of Europe; the Baku oil fields; the Caspian and lower Volga fisheries; the Transcaspian trade; the commerce of the Black Sea and the Bosphorus; and the proximity of the Moscow government to the great agricultural area of the Black Earth Belt, all afford a sound economic basis for the supremacy of the old capital. Before her the bureaucratic city on the banks of the Neva must sooner or later surrender an ascendancy made by man in defiance of geography. Besides, the movement of population in Russia is southward. Incidentally too it is worthy of note that the development of industrialism and commercialism at Moscow has already transformed the politics of this cradle of autocratic Tsardom; Moscow is no longer reactionary but progressive and liberal.

The progress of Russia has been tremendous in the last decade. The years since the Japanese war have seen the adoption of a constitutional régime, the rapid spread of industrialism, the greatest agrarian reforms since emancipation, and a remarkably intelligent study and handling of the problems of primary education, agriculture and intemperance. Along with this has come a clear appreciation of the richness of her resources. "In the markets of the world there exists to-day a famine in meat, lumber and breadstuffs," say the Russian economists, and Russia can produce all three to an indefinite amount.

Russia has a geographic basis for a great nation such as is possessed by no other people unless it be our own. It is wanting however in one important respect, it lacks an adequate coast line. Its outlet to the commerce of the western world is through waters dominated by

other powers, or by way of Archangel, which, like Petersburg, is ice-bound for a large part of the year. Nor are conditions better in the Far East where the premature insistence upon the possession of Port Arthur and the consequent war with Japan was largely due to the desire for an ice-free port on the Pacific. Russia's means of access to the world's commerce are too circumscribed for so large a state, and she is bound to demand a readjustment favorable to her interests from time to time. Indeed that is what she has been doing for centuries; her coast-ward movement has been in progress for at least four hundred years and we are witnesses to-day of another gigantic step in this direction. The Germans block the way, and ultimately, combined with them, the Swedes and Danes. That Russia with her population of 175 millions, increasing at the rate of nearly three millions a year, and with resources so vast and undeveloped that they can only be roughly estimated, will be kept permanently bottled up is not likely. Her coast-ward advance, however, is likely to follow lines of least resistance and the conquest of an outlet by way of Constantinople to the world's trade is as inevitable as is its geographic reasonableness. Towards the Persian Gulf the way is also open and inviting. Indeed everywhere in Asia she has the unique advantage of internal lines of development and therefore also of attack. Geographically the serious menace to British world supremacy does not lie in Germany but in Russia.

In the past great rivers and flat plains invited expansion over immense areas of forest, swamp and rich agricultural lands. To-day the lure of rich trade routes and the consequent attraction of the sea is fascinating the eastern Slav. He is building his roads, railroads and canals, and sending colonists out into unoccupied land very much as did the United States in the nineteenth century. Once this is occupied, the push to the sea will be irresistible. This youthful giant among the nations of the world is beginning to realize his great strength; the resignation and despair of the peasant empire is giving way to a New Russia full of confident assurance.

GEOLOGICAL METHODS IN EARLIER DAYS

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WHILE reading discussions of modern field and office methods, published in *Economic Geology,* I became impressed with the feeling that some notes, historical and reminiscent, respecting conditions and methods of forty and more years ago, should be placed on record for the benefit of the younger geologists. The reminiscences are confined to my own experience, which, however, did not differ from that of contemporary workers.

Popular interest in natural history was quickened, early in the nineteenth century, by the formation of societies and the founding of museums. Efforts to secure cooperation by the central government were so far successful that surgeons accompanying exploring expeditions, in charge of army officers, were chosen as much because of willingness to act as collectors as because of medical skill. Very soon, natural history came to be regarded as, at least, lending dignity to an expedition's work, so that an army-explorer looked upon his equipment as defective unless it included a naturalist; a report without an appendix or a series of appendices, discussing collections secured by the party, seemed to be painfully incomplete. After the first third of the century had passed, geology acquired some degree of popular respect as a practical science and it received recognition from the War Department. The making of geological observations became part of the duty assigned to the naturalist-surgeon. In almost every case, however, the work of the naturalist or geologist was merely incidental and his opportunity to obtain detailed information was limited.

In the later sixties, after the close of the Civil War, the War Department, through the corps of engineers, began exploration anew. Clarence King's organization was under this Bureau, but he was not subject to military control in the field; his only hindrance was the pressure for results to prove speedy productiveness and to satisfy inquiring legislators that the field-work had not been merely a prolonged picnic. Somewhat later, an organization of the earlier or reconnaissance type was effected and was placed in charge of Lieutenant George M. Wheeler, who was endowed with extraordinary energy and with such physical endurance as to be a source of pain to all members of his party. In 1872, Wheeler became convinced that, without geological and other scientific contributions, his work would be incomplete, for Hayden had already loomed large on the horizon. The scope of the organization was

enlarged and G. K. Gilbert, with E. E. Howell, was appointed, each being attached to a party as geologist. In 1873, there was farther enlargement and a party was formed to map and to explore about half of the mountain region of Colorado, with as much of New Mexico as possible, an area of not far from 30,000 square miles, containing much extremely complicated geology. J. J. Stevenson was assigned to this party as geologist. The party consisted of Lieutenant (now Brigadier-General, retired) W. L. Marshall, two topographers, three "scientific workers," an imposing array of packers and an escort of 25 infantry soldiers, who were to serve as protection against Indians. There were some good men in this escort, but before the season was well underway, there seemed to be reason for supposing that the authorities at Fort Leavenworth had unloaded their guardhouse on us. Ninety six mules of varying temperaments completed the equipment.

The request for a large appropriation from Congress had been enforced by proof that the work of previous years had been done at an almost incredibly small cost per square mile—and the argument was effective. The work in 1873 was to be an improvement on that of the past but the importance of economical operation was not to be forgotten. The geologist received a small mountain aneroid, a clinometer compass, a pocket level and a hammer; the naturalist-surgeon was equipped with a Spencer carbine of large bore, that he might shoot birds and other small animals; the collector in botany had his presses; the youthful barometer-carrier had his burden strapped on his back; the expedition was ready to start. After a series of misunderstandings with the mules, one of which led to a stampede which startled the youthful city of Denver, the party set forth in single file, as is the manner of mules.

The geologists associated with the Wheeler organization had gained some experience in the field, chiefly in connection with the Ohio survey, and they had gone with Wheeler in search of a wider field of usefulness. The field of the Colorado party proved very useful to me, but very soon I had misgivings as to my usefulness in that field. It became evident very quickly that geography, not geology, was the objective, and that the important elements in equipment of a geologist for this work were a lively scientific imagination and ability to solve stratigraphic puzzles by intuition. There was no map and the topographer's notebook was of little service. The direction of travel was determined by conditions, so that, without a map, one could not keep his bearings in the maze of valleys and cañons. The topographer was always secure, as the expedition was for him, but the geologist was in constant uncertainty. If he saw a section, which might relieve his perplexity, he was in anxious concern, knowing that if he measured the section, the train would disappear and he might be as a man hunting the needle in a haystack. But he had to secure sections, he had to examine anomalous exposures,

and afterwards he had to find the train. The conditions made for rapid movement when at work, for keenness of observation, for quickness of perception, for promptness in decision as well as for error in conclusion. The geologist learned to follow the track of the train, but the close watch for crushed grass or for fleeting footprints in sand prevented him from seeing important features during his hasty ride.

In comparing the work of the earlier days with that performed more recently, under better conditions and with the aid of the earlier reconnaissances, I have been astonished that so much, and the word is used advisedly, has endured the test of friendly as well as of unfriendly criticism. It is surprising that geologists, slung about as bobs on the tail of a topographer's kite in a wholly unknown region, succeeded so well in gaining knowledge of the general structure; they failed only where they attempted detailed description or discussion. Maps were prepared slowly after the season closed and when the geologist received them, a year or more afterwards, they were a mystery. Streams followed wholly unsuspected directions; localities were in relations very different from those conceived when the work was in progress; in critical places the map was altogether unlike that drawn in the geologist's mind. It was impossible to bring the imagined into harmony with the real, so that some portions were colored on the basis of a mental reconnaissance. Geologists attached to the Hayden survey were at somewhat less disadvantage because the work was primarily geological; but they were hampered very seriously in other directions. In those early days the importance of surveys was not recognized; in order to secure appropriations it was necessary to produce bulky reports referring to great areas; there was no time for careful work, yet several geologists associated with Hayden made remarkable studies and solved intricate problems. The Powell survey, because of the Major's marvelous skill in manipulation of Congressional committees, was hampered much less, and the work done by Gilbert and by Dutton is of lasting importance.

Geological surveys in individual states were begun very early but, except in Massachusetts, they were shortlived and on a small scale. The great surveys of New York, Pennsylvania and Virginia were begun in 1836. At that time, there were practically no geologists in the country; of those known as mining engineers, not more than five or six had received any geological training. The geological surveys were entrusted mostly to young men; Rogers of Virginia was 32; his brother in Pennsylvania was 28; in New York, Mather was 32, Vanuxem was 44, Emmons, 37 and Hall, 25. Among the assistants on the Pennsylvania survey were Lesley, 20, Hodge, 21, Jackson, 23, Haldeman, 24. The country in much of Virginia, Pennsylvania and Ohio, even in New York, was little better than a wilderness, eighty years ago; railroads

were practically unknown and there were few graded roads; aneroids were mere toys and Locke had not invented his pocket level; there were no instruments except those of cumbrous size; boiling point thermometers were tried but they proved worthless; there were few maps and such as did exist were misleading. The young men, without previous training, without instruments of any sort, except a compass, and without maps, were thrown into the unexplored region. It has been my privilege to reexamine much of the area in which they labored. How they obtained their results passes comprehension; they carried the Bituminous section in Pennsylvania and Virginia with wondrous accuracy, though at times there were intervals of miles in which no exposures existed except along streams flowing through the woodland. It is easy now to discover inaccuracies in their work, for men can examine it, so to speak, with a microscope. These early geologists, for the most part, were men of gigantic intellect and noble integrity.

With the close of these surveys in 1842 to 1845, extended work came to an end. Some organizations were continued in a moderate way, but all except those of Illinois and New York were broken up by the Civil War, and there was no revival until the later sixties. Meanwhile the condition existing in 1836 had returned. Not more than 30 men survived who had been trained in field work; some of these had gone into special work as mining engineers, others were in enfeebled health, and others still were in positions less onerous and more remunerative than survey work. Probably not more than ten men were available in 1869, and several of those were attached to surveys not interrupted by the Civil War.

The Ohio survey, reorganized in 1869, had as its director the veteran Newberry, who, as a young physician, had entered the United States service during the Pacific Railroad explorations. As a lad he had collected fossil plants from the roof of his father's coal mine in Ohio, and in later years he had studied paleobotany under Brongniart in Paris. His work as geologist, botanist and zoologist on the Pacific Railroad explorations was brilliant, but in importance was far excelled by his later geological work on the Ives and Macomb expeditions. Of his assistants on the Ohio survey, only one could be regarded as a professional geologist; the others were amateurs. Of the aids and coworkers, not more than three had done any field work and the most of us were wholly inexperienced. We were expected to succeed without help, as our predecessors had done; an area was assigned to each man and he was told to get at it. The state maps were good, but on a small scale; the general structure had been worked out by the Mather survey long before, and both Newberry and Whittlesey had published small outline maps; but, as far as details were concerned, the region was a *terra incognita*.

Did we make blunders? We simply reveled in ignorance; we learned by making mistakes and by occasionally discovering some of them. We did not know for what to look, but we looked at everything, for everything was a revelation. Some of the worst errors in correlation were due to this. On my third day, while day-dreaming over what seemed to be a remarkable phenomenon, I lost hold of the section, and in crossing the divide committed an error which affected my work throughout that summer and the next. There was no opportunity for revision; the western method of reconnaissance prevailed and a line once covered was completed. The young men, who did the work for their expenses, gained a vast amount of knowledge but not much modesty; they had been found capable of doing a new type of work without assistance. The rod of correction was applied somewhat more than ten years later by Professor Edward Orton, Sr., but the application was made so gently, so courteously, that all of us were united in gratitude to the keen man who had harmonized conflicting observations and had corrected errors, but had administered no rebuke to the incompetent youths who had made them. Economically, the errors were unimportant as they were chiefly in correlation; the resources of state were described well and the observations were recorded honestly. A group of geologists were trained, who, under Orton during the third survey, knew for what to look, how to look for it and, better still, how to present their results.

The second survey of Pennsylvania was ordered by the Legislature of that state in 1874, forty years ago, and J. P. Lesley was appointed as director. Though a survivor of the first survey, discontinued more than 30 years before, he was still in the prime of his powers and, along certain lines, he was perhaps the ablest geologist in the country. But he had entered from the topographical side and all his work had been concerned with economic applications of geology. The survey had been ordered on an extensive scale that the mineral resources of the state might be determined in practical detail, so that it was necessary to publish prompt and somewhat voluminous reports in order to suppress recalcitrant legislators. In 1875 I was appointed geologist in charge of the southwestern district and entered upon the work with I. C. White as aid. It may be remarked in passing that, in state work, the geologist must contend with one serious cause of error which is unknown to the western explorer. Sleepless nights were rare during the western work, but in the civilized region, where one must live off the country, there is often the terror that walketh in darkness, which benumbs the geologist's intellect and blinds his eyes during the day.

Thirty-five years prior to our advent, Henderson had completed his work for the first survey and had reached the conclusion that, owing to lack of exposure, the upper part of the section would never be worked

out. During that interval there had been no change in conditions except that the region had been stripped of forest and numerous rude country roads had been made. There was no railroad, except at the extreme north; there were no extensive mining operations except on the Pittsburgh coal bed on the Monongahela River, and there were no records of oil borings except in the southeast corner where they were not needed. To add to the natural drawbacks, we were equipped with aneroids which were fearfully and wonderfully made. Lesley, unable to induce Becker to make a supply of high grade barometers, had procured a number of models to be tested. Those assigned to us were shaped like a hat box and were provided with vernier and other attachments, all of which had to be cared for at each reading, as otherwise the observation would be wholly worthless. Happily for us, our horses ran away one day; when the race was over and White's horse had won, we discovered with grateful hearts that the barometers were ruined. Thereafter we used our own barometers, which proved to be fairly good.

As soon as we had passed beyond 100 feet above the Waynesburg coal bed, satisfactory exposures became rare—and nine tenths of Greene County, in which we had begun, was above that horizon. The only recourse was to examine every bit of rock that jutted out on a hillside. Sections were made everywhere, 5 to 100 or more feet long, but the longer ones had tormenting gaps which refused to be filled. Strange anomalies appeared, which cast doubt on tentative correlations; limestone was found where we expected variegated shale; streaks of coal appeared in what seemed to be wrong positions; sandstone was seen where there should have been a coal bed. Our work proved that these are not anomalies and the conditions are commonplaces to-day; but 40 years ago the continuity of deposits was a cardinal doctrine and all limestones were marine. Our conversion was slow but it came, and little by little we were able to piece the fragments together; the section was completed as far as possible and doubt remained respecting only a few horizons, which were not economically important.

It would have been well if several localities could have been reexamined; a number of errors would have been eliminated which now are so evident that any one can note them. Revision is very different from original work, and is a very simple matter. If the original observer has recorded his observations honestly, the reviser needs no especial acumen in order to discover the errors. If White and I had had the advantage, 40 years ago, of the hundreds of oil-well records made in the Greene and Washington district during the last 20 years, our work would have been a holiday jaunt; we should not have been compelled to spend so many dreary days in securing fragmentary sections or so many weary nights in trying to combine them. But there were no well records and there was no opportunity for revision. Too

much time had been spent in Greene; there remained the larger county of Washington and a great part of Allegheny to be studied.

The problems in Washington, though different, were equally perplexing for a time. Exposures were better, longer continuous sections were secured, but new members came in while familiar ones dropped out. We were firm believers in variation of intervals between coal beds, but were not prepared for the variations which had been accomplished in the deeply buried portions of the section within northern Greene and southern Washington and which were revealed under an anticline in Washington. The imperfect record of a coal shaft reaching the Pittsburgh coal bed removed all doubts and filled us with intense respect for such records. The work in this county was not difficult as the section had been mastered; the especial burden being to cover the region in detail before snowfall, as the report must be ready for the printer before adjournment of Legislature.

During this season's work our attention was concentrated upon correlation and economic questions; there was no time for studies concerning matters of purely scientific interest. So intent were we in consideration of those subjects that we neglected to make notes of features which are all-important in their bearing on problems relating to coal and coal beds. Having sinned in this way, it is not for me to cast stones at any one for a similar sin, provided it has been committed under similar conditions.

A serious difficulty encountered by geologists in the earlier work was the inaccuracy of maps. One illustration suffices. In Fayette and Westmoreland Counties of Pennsylvania, I made use of maps which the county surveyors regarded as the least inaccurate. Professor Lesley had done some geological work in those counties and had discovered defects in the maps, which disturbed him greatly. He chose worse maps, corrected some errors in them and transferred my outcrop lines to the new base. The creations were put on the stone and proofs were sent to me. A single glance aroused feelings too deep for utterance and the proofs were returned without change. No doubt many other geologists can relate a similar experience.

Geologists, entering on field work within the last score of years, know little of the difficulties attending exploration forty or more years ago, especially in coal areas, where the effort was to trace thin deposits throughout extensive areas; though exception should be made in favor of those laboring in similar areas at the far west, where dependence must still be placed on natural exposures. In by far the greater part of the country the structural geology has been worked out during more or less reconnoissances, so that when the reviser entered the field he found everything so simple that he was astonished that any one should have been perplexed and still more astonished that mistakes were

made. The structure of the Elk mountains in Colorado is distinct and every feature stands out so sharply that a child in geology can read the story. But the case was very different before W. H. Holmes recognized in the crumpled mass of fragments merely a crushed, faulted fold and restored the original lines. The symmetry of the Jura mountains is the admiration of geologists, but the key to unlock its case of mysteries was not found until H. D. Rogers, fresh from his Appalachian studies, proved the simplicity of its structure. The older geologists made our geology. In most of the United States, Canada and Europe, the share of recent geologists is like that of workmen who fill up cracks in the walls and interior of a building and put on the finishing touches, that the edifice may be the better fitted to resist the ravages of time.

The writer is not of those who believe that the older days were better than these or that the geologists of half a century ago were superior to those of our own day. Such a conception would be arrant folly. But he is convinced that in some respects the work of too many geologists is defective and that the cause is not hard to find. The methods are too refined and dependence on them tends to make the process too mechanical. The older geologists had practically no appliances except their eyes, and comparatively few of them had more than a passing knowledge of topography. The contrast appears sharply in the reports. The writer, in endeavoring to ascertain conditions prevalent during deposition of coals in the United States and Europe, has examined carefully scores of thousands of pages in several languages, so that he writes feelingly. Within recent times the tendency has been to record chiefly such observations as have the accuracy of instrumental determination. Other matters seem to be unimportant; they are commonplaces, unworthy of record. Yet those commonplaces are the essentials of pure geology. Certainly, one is justified in asking that men who have only to revise, with the aid of later developments, the work of other men, should add greatly to knowledge in the province of pure geology. It is more than probable that the demand for economic facts dulls the vision for other things, as it did too often 60 years ago, but there is room for protest against continuance of the condition. One may be pardoned for expressing the conviction that the weird work of Land Classification for the United States is likely to be, as it were, a red-hot iron rod passed close to the eyes of probably the ablest corps of geologists this world has known.

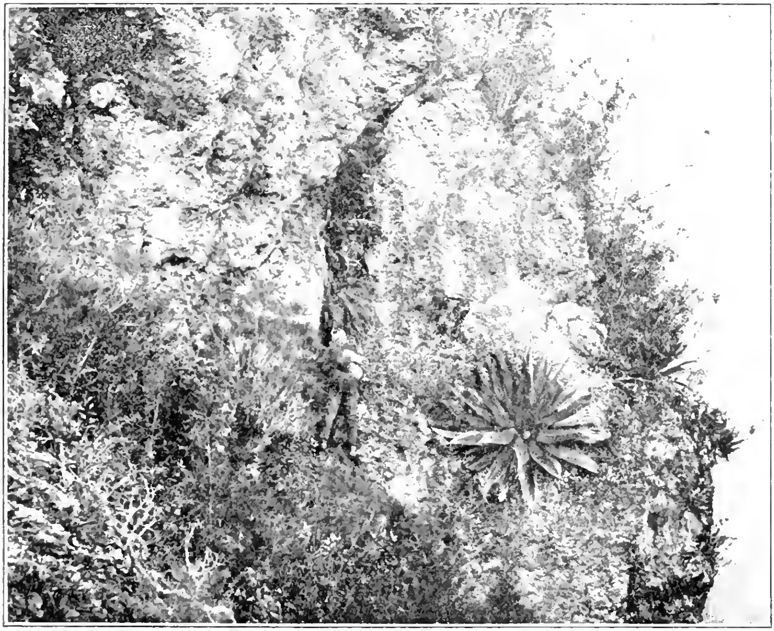
THE CINCHONA BOTANICAL STATION. II

By Professor DUNCAN S. JOHNSON,

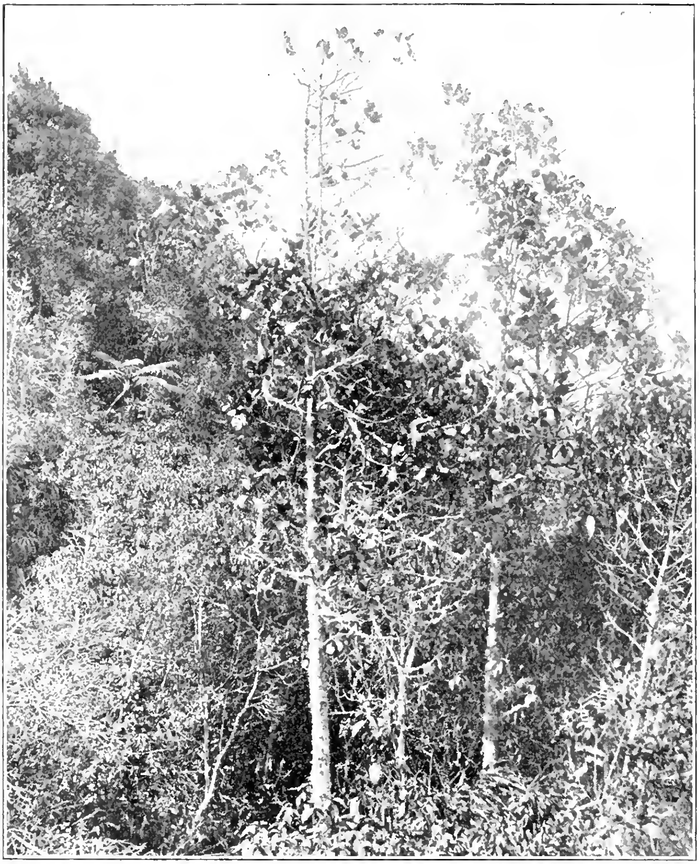
THE JOHNS HOPKINS UNIVERSITY

The Native Vegetation of the Cinchona Region

The native flora of Cinchona Hill is a varied and interesting one. Being south of the mountains, and on a sharp ridge with perfect drainage, the soil often gets quite dry. Especially is this true of the small pockets of humus in the rock clefts occupied by the numerous rock xerophytes, and of that gathered on the limbs of trees or held among the clustered roots of epiphytic orchids. We find here, therefore, many species characteristic of these xerophytic habitats. There are century plants, leathery-leafed ferns, aroids, bromeliads, orchids and *Peperomias* growing in the clefts of the rocks and on the branches of trees and shrubs. Climbing or creeping ferns, aroids, orchids, milkweeds and cacti run over the ledges and larger plants. On the branches of the juniper and *Dodonaea*, of the thick-leafed *Vaccinium*, and even of the nearly leafless *Baccharis* on the dry hillsides, many species of leafy or



Cliff with Xerophytic Plants. A century plant in its native home.



Two Cinchona Trees.

cactus-like mistletoes are thickly scattered. These half parasites win out in the struggle against drouth by allowing other plants to find water for them.

In the moist hollows, or on northern slopes of Cinchona Hill, many plants of temperate zones have established themselves, being brought there, presumably, with vegetable seeds imported from England. Clover, dandelion, dock, mullein, plantain and yarrow grow beside the trail. Wild strawberries bloom and ripen throughout the year. Side by side with these old acquaintances are thick clumps of the spicy-flowered wild ginger, and, towering over them are orchids and begonias as high as the head, canes and bamboos twenty feet tall, gray-barked, red-leafed cinchona trees and brilliant-flowered Melastomaceous shrubs. The lantana, Cherokee rose, passion flower, prickly-leafed ferns and the wiry-stemmed grass *Chusquaea* clamber over every thicket. Ferns abound everywhere, in sun or shade, and in moist or dry situations. Along one trail from

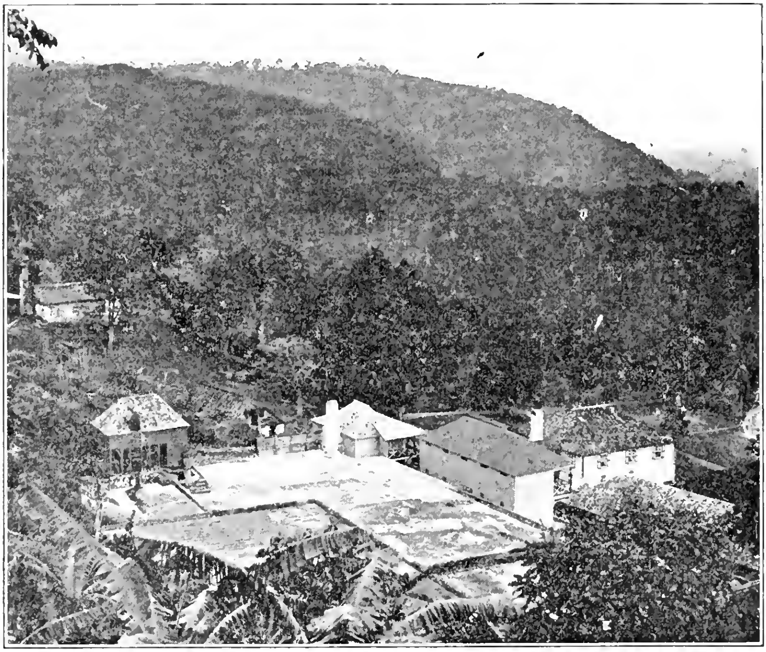
Cinchona, toward the mountains, a hundred species of ferns may be seen in an hour's walk without leaving the path. Professor Underwood estimated that four fifths of the 500 species native to Jamaica occur within a day's ride of Cinchona. We may well note, by way of comparison, that but one hundred and fifteen species are given in Gray's Manual for the whole northeastern United States.

Lower down, for we have been speaking hitherto of the levels near that of the Cinchona residence, the vegetation on this south side of the Blue Mountains becomes more luxuriant in the valleys and more xerophytic on the ridges. In the former the trees, such as *Alchornea latifolia* and *Prunus occidentalis* grow to a height of 60 or 70 feet, and lianes, such as *Maurandia*, *Begonia*, *Rhynchosia* and *Bidens* climb to their tops, while a new series of ferns and shrubs make up the undergrowth. On the ridges also the plants have a different aspect. There are new species, to be sure, but even the same species, *e. g.*, certain ferns,

EDGE OF FOREST. *Polypodium*, *Chusquaea* (at ×) and other climbers.

that in the damper regions above may be two feet or more in height, are reduced, on the exposed rocks of the hotter lowlands, to pigmies of but two or three inches when mature.

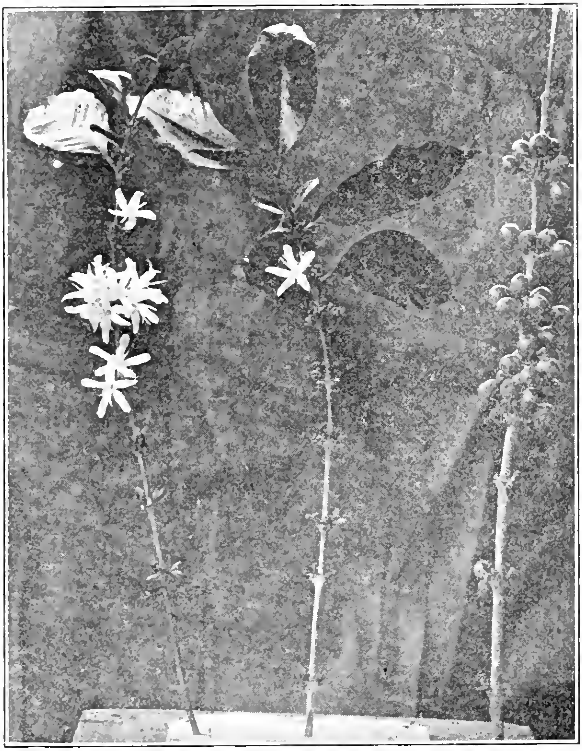
On hundreds of acres of the rocky hillsides for 2,000 feet below Cinchona is raised the Blue Mountain coffee, which Jamaicans, and the London coffee tasters, say is the finest coffee in the world. The coffee beans, the seeds of a small Abyssian tree related to *Cinchona,* are borne, two together, in each of the bright red, cherry-like fruits. The trees are grown on the steep, rocky ground, with oranges or bananas scattered in



Coffee Planter's Home with Cement Drying Floor (Barbecue). Pulping mill and windrows of drying coffee at left.

for shade. They are cultivated entirely by hand and are pruned down to five or six feet for convenience in picking the berries. The coffee beans are freed from pulp, shelled out of the parchment after drying, winnowed and polished, sometimes by gasoline engines, but usually by water power from the mountain streams. The beans are then sorted to sizes by screens, culled over by hand, and sent to Kingston, 15 or 20 miles away, on pack mules. Other parts of the cleared ground below Cinchona are planted with vegetables by the negro natives. These temporary tenants clear the land, raise potatoes, cabbages, scallions (onions), beets, yams and coco root, for three years on it and leave it with a good set of young coffee trees in payment for the lease.

Two miles north of Cinchona and at the same level, 5,000 feet, there is a notch in the main mountain range known as Morce's Gap. As one passes northward through this gap one sees the aspect of the vegetation change with surprising suddenness from that characteristic of the immediate neighborhood of Cinchona. Here, on the windward side of the mountains, everything reeks with moisture, for during most of the year clouds or mist drift through these gaps continuously from the cool north side of the mountains. Rain falls almost daily for much of the year,



Berries and Flowers of Coffee.

and even when it is not raining the clouds form and float through these dark forests. Ferns are in their glory here in this dense montane rain forest. There are scores of tree ferns, of half a dozen species, with stems three to six inches thick and ten to thirty feet high. Their straight slender trunks contrast strikingly with the forked, twisted branches of the *Podocarpus*, prune and other trees among which they are scattered. Most of the trees on some half-acre patches are tree ferns of the genera *Alsophila* or *Cyathea*. Their beautiful umbrella-like crowns are seen best from a hillside above them, or when their delicate plumes are outlined against the sky. Under these ferns and the other

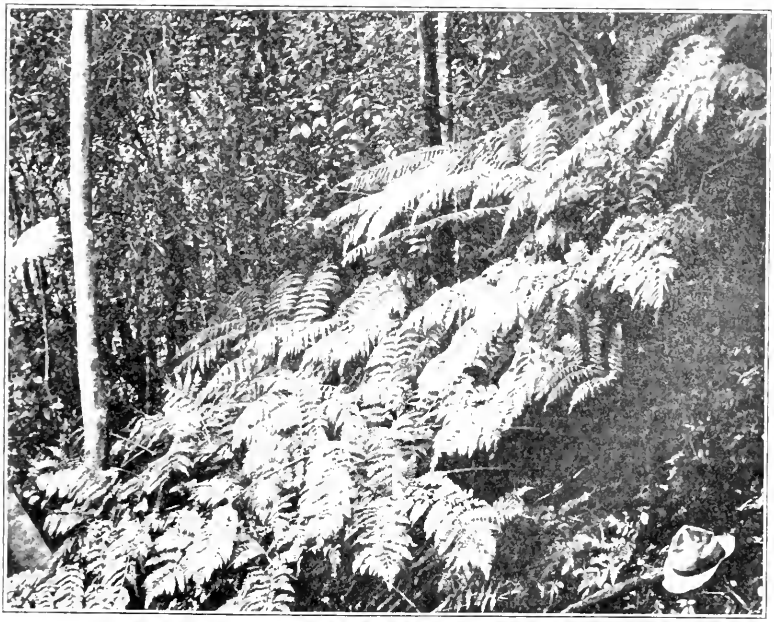
TREE FERNS AT BOTTOM OF A VALLEY.

trees are *Davallias* and *Danaeas*, with *Nephrodiums* and *Aspleniums* of many varieties. *Gleichenias* and *Davallias* fringe the trails, while *Lomarias*, *Trichomanes* and *Polypodiums* twine about the tree trunks and epiphytic *Acrostichums*, *Elaphoglossums*, *Polypodiums* and *Lycopodiums* settle on the stems or branches of *Cyathea* and other trees. The beautifully delicate *Hymenophyllum* and *Trichomanes* form thick carpets over damp cliffs, and over living or dead trunks. Even high up on trunks or branches they may form dense tufts or lace-like curtains. These filmy ferns here take the place, in part, of the mosses of our northern forests, on soil, rock and trunk. But the mosses themselves are here also to war with their competitors for standing ground and sunlight. Mingled with *Collema* and other lichens, the mosses form spongy tufts

over trunks and branches clear to the tops of the trees. Other species hang from the trees and lianes in festoons a yard or two in length.

The seed plants also of this rain forest show the same diversity of habit. There are dozens of climbers and twiners, such as *Bidens, Marcgravia, Sciadophyllum* and *Rhynchosia*, which cling to the trunks of the larger trees and so make their way up to the light. The *Marcgravia* is especially interesting from its possession of honey cups, which tempt the humming-birds that accomplish the pollination of its simple, inconspicuous flowers. Scores of bromeliads and orchids, as well as the ferns mentioned above, have become air plants, entirely without any connection with the ground. These epiphytes collect water and the solid food needed either from material falling into their cup-like leaf clusters, or absorb them as they drip down over the bark of the supporting tree. Indeed, *trees* of some size may find the necessary soil and water in the turfs of smaller air plants and the débris accumulated by them, even forty or fifty feet from the ground on the limbs of a big *Podocarpus*. The very leaves of trees, shrubs and of the more persistent herbaceous plants may become covered with epiphytic lichens and liverworts. In all these cases the air plants are not parasites, but simply use the trunk, branch or leaf as a standing place in which adequate light is available. In the lowlands we saw certain of these air plants actually flourishing on telephone wires.

If we go northward from Morce's Gap and down 2,000 feet into the



Marattia ON A HILL SIDE.

Podocarpus Tree and Tree Fern beset with Epiphytic Bromeliads and Ferns.

Mabess Valley, we find a region of much higher temperature and of still more constant rainfall. Here the vegetation becomes even more luxuriant, and, though made up of similar vegetational types, it includes many new species of ferns, like *Rhipidopteris peltata* and *Lygodium volubile.* There are high-perched tufts of brilliant *Pitcairnias* on the ledges. *Canna* and its relative *Heliconia,* with the thatch palm, *Geonoma,* grow along the stream, while clumps of the beautiful Rubiaceous shrub, *Cephaelis punicea,* are scattered on the slopes higher up.

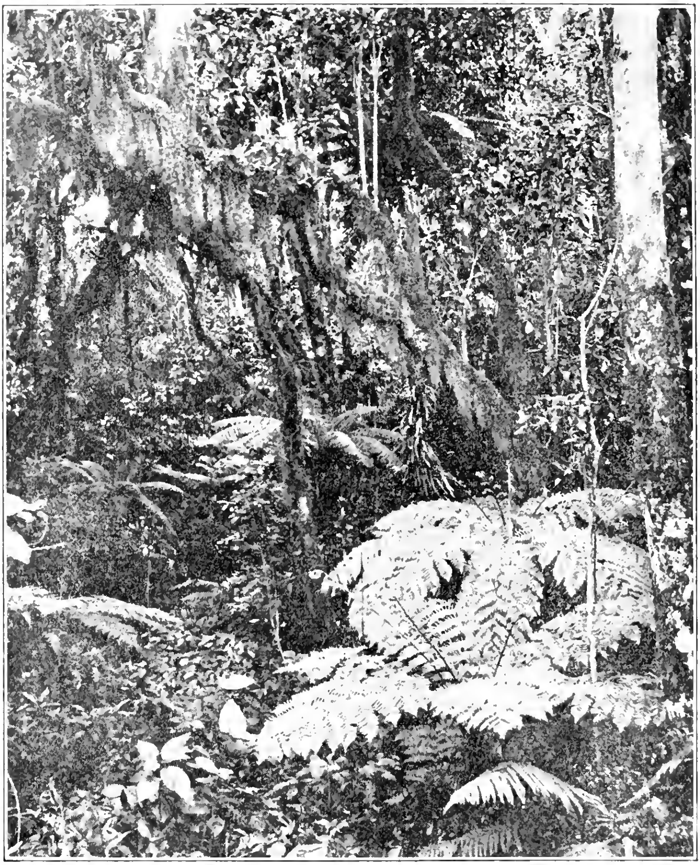
On climbing the high peaks near Cinchona, such as John Crow, on the west, or Sir John and Blue Mountain Peak, on the east, one finds still other interesting and novel vegetational features to enlist the attention. The trees on the ridges are bent and twisted. The more or less

horizontal branches are interlaced in a way that makes following the "trail" a rather perplexing combination of climbing over, creeping beneath and squeezing between the dripping, moss-covered trunks and branches. These experiences are varied, however, on other parts of the ascent, by slipping down, while attempting to creep up, the steep, grass- or fern-covered slope of a particularly lubricous clay. New forms appear with increasing altitude, many of them rarities. The tops of these peaks are occupied by low, gnarled trees of *Podocarpus Urbanii,* and by head-high, mistleto-covered bushes of *Vaccinium meridionale* and *Clethra alexandri,* or by wide stretches of the fern *Gleichenia* or the grass *Danthonia shrevei.* The northern slopes of these Blue Mountains, down to the 2,000-foot level, are practically unexplored territory, with no trails, except that skirting the Mabess Valley.

All the points here mentioned, except Blue Mountain Peak, are

TREE FERN WHOSE TRUNK IS COVERED WITH EPIPHYTES AND CLIMBERS.

within four or five hours' walk from Cinchona, and they thus offer the investigator very diverse specific and vegetational types within easy reach of the station. Any one of them also could be made a substation at which an investigator resident at Cinchona could carry on physiolog-



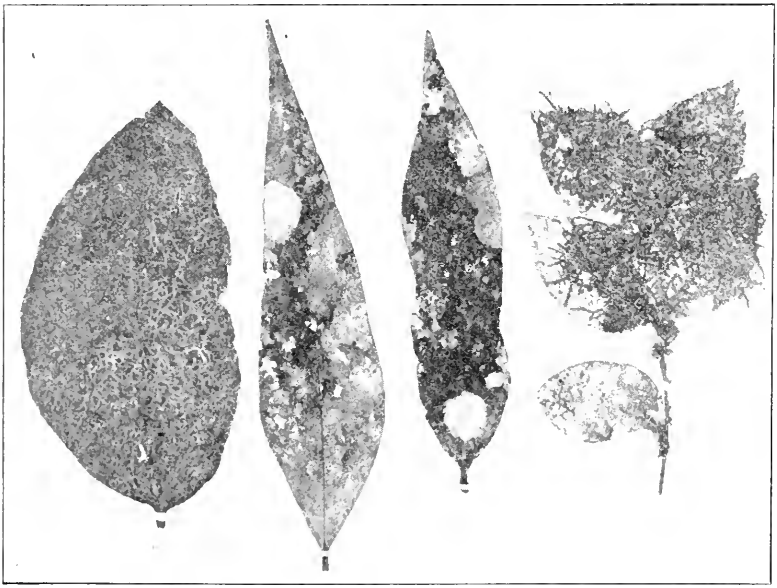
SWAYING TUFTS OF MOSSES HANGING FROM BRANCHES ABOVE YOUNG TREE FERNS.

ical or climatological work. Indeed, the variety of conditions available is far greater than has been indicated. Within half a day's ride from Cinchona a botanist can reach the steaming tropical lowlands of the north side of the island, the warm valleys and dry ridges of the southern slopes, and even the hot plains, coastal deserts, mangrove swamps and coral reefs of the south shore.

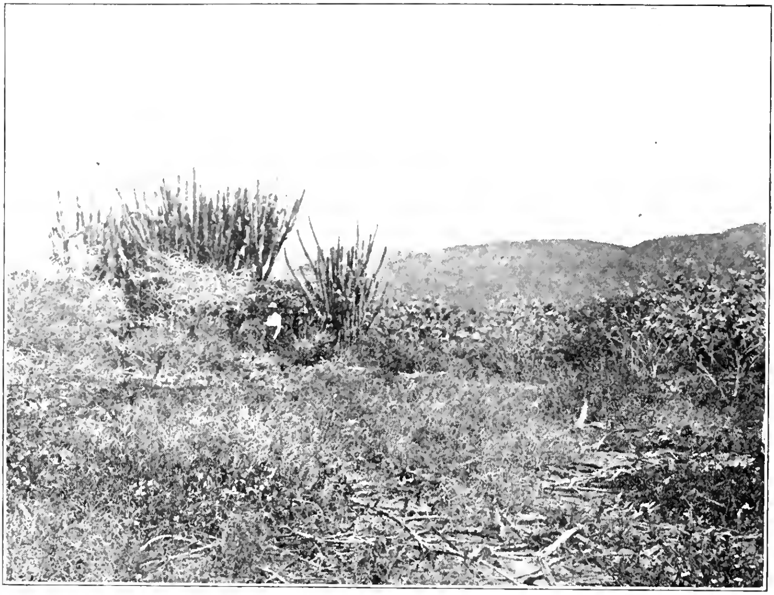
ADVANTAGES OF CINCHONA AS A TROPICAL STATION

It will make clear the unusual fitness of Cinchona as a tropical station if we here summarize its various advantages of location, surroundings, equipment and accessibility.

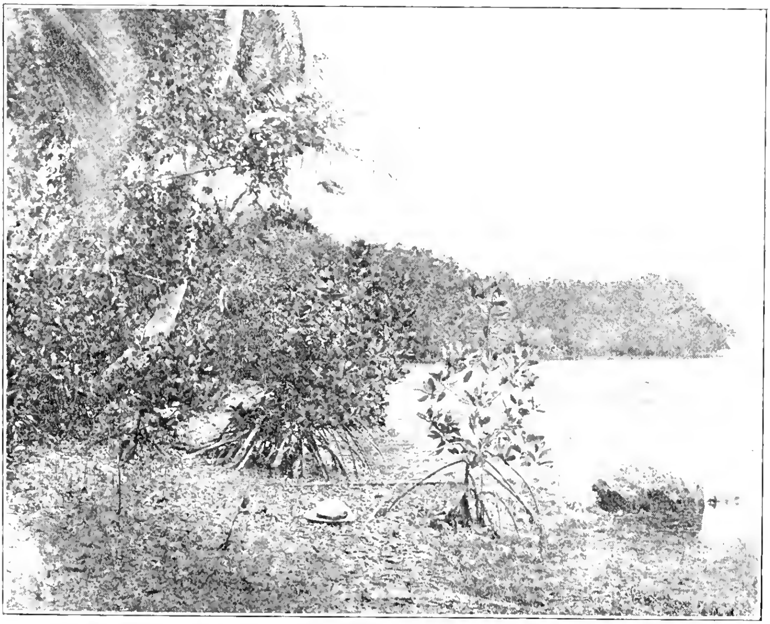
HANGING GARDEN. Twenty-five species of ferns and seed plants growing upon the limb of a tree forty feet above the ground. At left are the erect stems of two *epiphytics*.



EPIPHYTIC LICHENS AND LIVERWORTS ON LIVING LEAVES OF SHRUBS AND TREES.



Cacti and Giant Milkweed, *Calotropis*, on Desert Southern Seacoast.



Cocoanut and Mangroves (Mature Ones in Background) on Swampy South Coast of Jamaica.

In the first place it has that supremely important requisite, a primeval forest. There are scores of square miles of this within easy reach of Cinchona. It is only in such a forest that the extreme complexity attainable in a plant formation can be seen. Moreover, Cinchona is located in a botanical garden where scores of exotics are established, and where greenhouses, propagating grounds and helpers of some experience are available for collecting and growing material.

Secondly, because of the small size and irregular topography of the island of Jamaica, areas furnishing many varieties of conditions, from mountain peaks to coral reefs, can be readily reached from Cinchona. For example, there are about Cinchona 25 square miles of mountainous

A Leafless Silk Cotton Tree bearing Numerous Fruits. All the foliage in the crown of this tree belongs to the thousands of epiphytes on its branches.

country above the 5,000 foot level, and 140 square miles above 3,000 feet. There are also within reach river bottoms and sandy or rocky, desert or swampy sea coasts.

Thirdly, there are already two botanical gardens established in the lowlands where they can be used as substations for the study of problems concerning plants of these regions. One of these, Castleton, is in a damp region at 500 feet elevation, where it has a rainfall of 140 inches and a mean temperature of 75 degrees. The collection of plants here includes many ferns, cycads and screw pines, over a hundred species of palms, fine examples of *Ficus* and numerous other dicotyledonous trop-

Entrance to Castleton Gardens. The palm above the gate (*Attalea*) has leaves ten yards long and two yards wide.

ical trees. The other garden, which is at Hope, is on the dry Liguania plain, slightly higher than Castleton, but with a mean temperature of 76 degrees, and a rainfall of only 61 inches. At Hope Gardens there are an excellent library, laboratory accommodations, and very interesting collections of living orchids, cacti and economic tropical plants. For one wishing to study the marine algae it would be readily possible to secure rooms or a building on the water front, at Kingston or Port Royal. It is probable also that a marine zoological station will soon be established at Montego Bay, and will be available for botanists wishing to study the algae of that region.

A fourth very important advantage of Cinchona is that it is located in the healthy highlands where the climate is stimulating for workers from the temperate zones; where the water supply is pure, and where malaria and enteric troubles are not to be feared. Professor Goebel, after having much experience in tropical travel, wrote, when advising the Tropical Laboratory Commission referred to above:

> If at all possible the main station should be in the highlands, with a subsidiary station in the lowlands or on the seashore for the study of the algæ, and the vegetation of tropical plains.

It means much also to workers of normal social instincts, especially to those who are to settle down at such a station for some months, to be

able to work in pleasant surroundings, and to have interesting neighbors outside the laboratory, when there may be few fellow-workers within. At Cinchona, with its comfortable house and delightful garden, with its splendid views of mountain and valley, of Kingston Harbor with its gliding ships and twinkling lights, the worker is assured of restful diversion for his leisure hours. Nor need he entirely lack pleasant association with his fellow man, though his nearest neighbors, coffee planters, are several miles away. The planter leads an active outdoor life in the invigorating climate of the hills, but he finds time for sociability, and at four o'clock he is indoors for tea. This custom is clung to as faithfully here as on the banks of the Thames. This is the time of day when one's next door neighbor, from two or three, or even from five or six miles away, rides over for tea, for a chat over the news of the Hills, or perhaps for a game of tennis. The temporary tenant of Cinchona may

CORNER OF CASTLETON GARDEN, WITH CYCADS, PALMS AND *Araucarias*.

always feel sure of a welcome at these neighborly gatherings. In fact he must needs be careful, if his collecting trip should take him across a plantation at tea time, not to be captured by the proprietor. Within the planter's home the visitor will find many of the comforts and some of the luxuries of modern life. There are books, magazines and newspapers that keep the planter in touch with the outside world. Often there is a piano, brought ten or fifteen miles over the mountain trails on the shoulders of negroes. Members of the family who play the instrument may often show good evidence of a training gained in England or on the Continent.

Finally, it is a matter of no small concern that a permanent tropical station for British and American workers, should be located in an English-speaking country, with a stable government and reliable sanitary control, and in one readily reached from the United States and Europe. Jamaica has the advantage of not being subject to revolutionary upheavals. Its quarantine against the entrance of tropical disease is strictly maintained, and there is a good postal service. There are 2,000 miles of good roads in the lowlands, and two of these already reach within five or six miles of Cinchona. Similar roads are soon to replace other of the well-kept bridle trails already built in the Hills. Thus by railroads, roads and bridle paths all parts of Jamaica are accessible from Cinchona. The island itself can be reached from the United States in four or five days, from five Atlantic ports, while the voyage from England takes but ten or twelve days.

We are to have available then a laboratory, readily accessible, and in a very favorable location, of which Professor D. H. Campbell, who has studied tropical vegetation in many lands, writes:

> I can think of no place where the fern vegetation is so rich and where other types of tropical vegetation are more accessible.

We believe the opportunity here offered will be more and more frequently embraced by botanists, and that this laboratory in the western tropics will doubtless, as was suggested by Goebel, "be of the very greatest importance to the science, and will give a strong impulse to the study of botany in America." Jamaica will then be honored among men of science for the maintenance of this laboratory, as Holland has been for the support of the famous station at Buitenzorg.

THE HARPSWELL LABORATORY,
August, 1914.

THE INDIAN'S HEALTH PROBLEM

By CHARLES A. EASTMAN, M.D. (OHIYESA)
AMHERST, MASS.

THE physical decline and alarming death rate of the American Indian of to-day is perhaps the most serious and urgent of the many problems that confront him at the present time. The death rate is stated by government officials at about 30 per thousand of the population—double the average rate among white Americans. From the same source we learn that about 70,000 in the United States are suffering from trachoma, a serious and contagious eye disease, and probably 30,000 have tuberculosis in some form. The death rate from tuberculosis is almost three times that among the whites.

These are grave facts, and cause deep anxiety to the intelligent Indian and to the friends of the race. Some hold pessimistic views looking to its early extinction; but these are not warranted by the outlook, for, in spite of the conditions named, the last three censuses show a slight but continuous increase in the total number of Indians. Nor is this increase among mixed-bloods alone; the full-blooded Indians are also increasing in numbers. This indicates that the race has reached and passed the lowest point of its decline, and is beginning slowly but surely to recuperate.

The Change to Reservation Life

The health situation on the reservations was undoubtedly even worse twenty years ago than it is to-day, but at that period little was heard and still less done about it. It is well known that the wild Indian had to undergo tremendous and abrupt changes in his mode of living. He suffered severely from an indoor and sedentary life, too much artificial heat, too much clothing, impure air, limited space, indigestible food—indigestible because he did not know how to prepare it, and in itself poor food for him. He was compelled often to eat diseased cattle, moldy flour, rancid bacon, with which he drank large quantities of strong coffee. In a word, he lived a squalid life, unclean and apathetic physically, mentally and spiritually.

This does not mean all Indians—a few, like the Navajoes, have retained their native vigor and independence—I refer to the typical "agency Indian" of the Northwest. He drove ten to sixty miles to the agency for food; every week end at some agencies, at others every two

weeks, and at still others once a month. This was all the real business he had to occupy him—travelling between cabin and agency ware-houses for twenty-five years! All this time he was brooding over the loss of his freedom, his country rich in game, and all the pleasures and satisfactions of wild life. Even the arid plains and wretched living left him he was not sure of, judging from past experience with a government that makes a solemn treaty guaranteeing him a certain territory "forever," and takes it away from him the next year if it appears that some of their own people want it, after all.

Like the Israelites in bondage, our own aborigines have felt the sweet life-giving air of freedom change to the burning heat of a desert as dreary as that of Egypt under Pharaoh. It was during this period of hopeless resignation, gloomily awaiting—what? no Indian could even guess—that his hardy, yet sensitive, organization gave way. Who can wonder at it? His home was a little, one-roomed log cabin, about twelve by twenty feet, mud-chinked, containing a box stove and a few sticks of furniture. The average cabin has a dirt floor and a dirt roof. They are apt to be overheated in winter, and the air is vitiated at all times, but especially at night, when there is no ventilation whatever. Families of four to ten persons lived, and many still live, in these huts. Fortunately the air of the plains is dry, or we should have lost them all!

Remember, these people were accustomed to the purest of air and water. The teepee was little more than a canopy to shelter them from the elements; it was pitched every few days upon new, clean ground. Clothing was loose and simple, and frequent air and sun baths, as well as baths of water and steam, together with the use of emollient oils, kept the skin in perfect condition. Their food was fresh and wholesome; largely wild meat and fish, with a variety of wild fruits, roots, and grain, and some cultivated ones. At first they could not eat the issue bacon, and on ration days one might see these strips of unwholesome-looking fat lying about on the ground where they had been thrown on the return trip. Flour, too, was often thrown away before the women had learned to make bread raised with cheap baking-powder and fried in grease. But the fresh meat they received was not enough to last until the next ration day. There was no end of bowel trouble when they were forced by starvation to swallow the bacon and ill-prepared bread. Water, too, was generally hauled from a distance with much labor, and stood about in open buckets or barrels for several days.

As their strength waned, they made more fire in the stove and sat over it, drinking rank coffee and tea that had boiled all day on the same stove. After perspiring thus for hours, many would go out into the bitter cold of a Dakota winter with little or no additional clothing, and bronchitis and pneumonia were the inevitable result. The uncured cases became chronic and led straight to tuberculosis in its various forms.

Furthermore, the Indian had not become in any sense immune to disease, and his ignorance placed no check upon contagion and infection. Even the simpler children's diseases, such as measles, were generally fatal. The death rate of children under five was terrific. I have known women to bear families of six or eight or ten children, and outlive them all, most dying in infancy. In their state of deep depression, disease had its golden opportunity, and there seemed to be no escape. What was there to save the race from annihilation within a few years? Nothing, save its heritage of a superb physique and a wonderful patience.

The Indian Service Physician

The doctors who were in the service in those days had an easy time of it. They scarcely ever went outside of the agency enclosure, and issued their pills and compounds after the most casual inquiry. As late as 1890, when the government sent me out as physician to ten thousand Ogallalla Sioux and Northern Cheyennes at Pine Ridge agency, I found my predecessor still practising his profession through a small hole in the wall between his office and the general assembly room of the Indians. One of the first things I did was to close that hole; and I allowed no man to diagnose his own trouble or choose his pills. I told him I preferred to do that myself; and I insisted upon thoroughly examining my patients. It was a revelation to them, but they soon appreciated the point, and the demand for my services doubled and trebled.

As no team was provided for my use to visit my patients on a reservation nearly a hundred miles square (or for any other agency doctor at that time), I bought a riding horse, saddle and saddle-bags, and was soon on the road almost day and night. A night ride of fifty to seventy-five miles was an ordinary occurrence; and even a Dakota blizzard made no difference, for I never refused to answer a call. Before many months I was supplied by the government with a covered buggy and two good horses.

I found it necessary to buy, partly with my own funds and partly with money contributed by generous friends, a supply of suitable remedies as well as a full set of surgical instruments. The drugs supplied by contractors to the Indian service were at that period often obsolete in kind, and either stale or of the poorest quality. Much of my labor was wasted, moreover, because of the impossibility of seeing that my directions were followed, and of securing proper nursing and attention. Major operations were generally out of the question on account of the lack of hospital facilities, as well as the prejudice of the people, though I did operate on several of the severely injured, after the massacre at Wounded Knee. In many cases, it was my task to supply my patients with suitable food and other necessaries, and my wife was

always prepared for a raid on her kitchen and store-room for bread, soup, sheets and bandages.

The old-time "medicine-man" was really better than the average white doctor in those days, for, although his treatment was largely suggestive, his herbs were harmless, and he did allay some distress which the other aggravated, because he used powerful drugs almost at random and did not attend to his cases intelligently. The native practitioners were at first suspicious of me as a dangerous rival, but we soon became good friends, and they sometimes came frankly to me for advice and even proposed to borrow some of my remedies.

Of course, even in that early period when the average government doctor feared to risk his life by going freely among the people (though there was no real danger unless he invited it), there were a few who were sincere and partially successful, especially some military surgeons.

Now that stage of the medical work among the Indians is past, and the agency doctor has no valid excuse for failing to perform his professional duty. It is true that he is poorly paid and too often overworked; but the equipment is better and there is intelligent supervision. At Pine Ridge, where I labored single-handed, there are now three physicians, with a hospital to aid them in their work. To-day there are two hundred physicians, with a head supervisor and a number of specialists, seventy nurses, and eighty field matrons in the Indian service.

Some Mistakes and the Remedies

Another serious mistake has been made in the poor sanitary equipment of Indian schools. Close confinement and long hours of work were for these children of the forest and plains unnatural and trying at best. Dormitories especially have been shamefully overcrowded, and undesirable pupils, by reason both of disease and bad morals, allowed to mingle freely with the healthy and innocent. Serious mishaps have occurred which have given some of these schools a bad name; but I really believe that greater care is being taken at the present time. It was chiefly at an early period of the Indian's advance toward civilization that both mismanagement and adverse circumstance, combined with his own inexperience and ignorance of the new ways, weakened his naturally splendid powers and paved the way for his present physical decline. His mental lethargy and want of ambition under the deadening reservation system has had much to do with the outcome.

He was in a sense muzzled. He was told: "You are yet a child. You can not teach your own children, nor judge of their education. They must not even use their mother tongue. I will do it all myself. I have got to make you over; meanwhile I will feed and clothe you. I will be your nurse and guardian."

This is what happened to this proud and self-respecting race! But since then they have silently studied the world's history and manners; they have wandered far and wide and observed life for themselves. They have thought much. The great change has come about; the work has been done, whether poorly or otherwise, and upon the whole the good will prevail. The pessimist may complain that nothing has come of all the effort made in behalf of the Indian. I say that it is not too late for the original American to regain and re-establish his former physical excellency. Why should he not? Much depends upon his own mental attitude, and this is becoming more normal as the race approaches, and some part of it attains to, self-support and full citizenship. As I have said, conditions are improving, yet much remains to be done, and it should be done quickly. An exhaustive inquiry into health conditions among the tribes was made in accordance with an act of Congress in 1912, and the report presented in January, 1913, was in brief as follows:

1. Trachoma is exceedingly prevalent among Indians.
2. Tuberculosis among Indians is greatly in excess of that estimated for the white population.
3. The sanitary conditions upon reservations are, on the whole, bad.
4. The primitive Indian requires instruction in personal hygiene and habits of living in stationary dwellings.
5. The sanitary conditions in most Indian schools are unsatisfactory.
6. There is danger of the spread of tuberculosis and trachoma from the Indian to other races.
7. Due care is not taken in the collection and preservation of vital statistics.
8. The medical department of the Indian Bureau is hampered by insufficient authority and inadequate compensation.

As a result of this and other investigations, increased appropriations have been asked for, and to a limited extent provided, for the purpose of preventing and treating disease, and especially of checking the spread of serious contagious ailments. More stress is being laid upon sanitary precautions and hygienic instruction in Indian schools, and an effort is made to carry this instruction into the Indian home, through field matrons and others. Four sanitoria or sanitarium schools have been successfully established in suitable climates, and it is recommended by an Indian Service specialist that certain boarding-school plants be set apart for trachoma pupils, where they can have thorough and consistent treatment and remain until the cure is complete. Much larger appropriations are needed in order to carry out in full these beneficent measures, and I earnestly hope that they may be forthcoming.

It is interesting to note that whereas a few years ago the Indians were reproved for placing their sick in canvas tents and arbors, and in every way discouraged from any attempt to get out of their stifling

houses into the life-giving air, sleeping-porches are now being added to their hospitals, and open-air schools and sanatoria established for their children. The world really does move, and to some extent it seems to be moving round to the red man's original point of view. It is not too late to save his physique, as well as his unique philosophy, especially at this moment, when the spirit of the age has recognized the better part of his scheme of life.

It is too late, however, to save his color; for the Indian young men themselves have entirely abandoned their old purpose to keep aloof from the racial melting-pot. They now intermarry extensively with Americans and are rearing a healthy and promising class of children. The tendency of the mixed-bloods is toward increased fertility and beauty as well as good mentality. This cultivation and infusion of new blood has relieved and revived the depressed spirit of the first American to a noticeable degree, and his health problem will be successfully met if those who are entrusted with it will do their duty!

My people have a heritage that can be depended upon, and the two races at last in some degree understand one another. This is his native country, and its affairs are vitally his affairs, while his well-being is equally vital to his white neighbors and fellow-Americans. I have no serious concern about the new Indian, for he has now reached a point where he is bound to be recognized.

WHAT ANIMAL EXPERIMENTATION HAS DONE FOR CHILDREN

By HENRY DWIGHT CHAPIN, M.D.

NEW YORK

THE rich contribution that animal experimentation has yielded to the direct, curative treatment of disease is well known to all educated physicians. The lay public, however, seem to be insufficiently informed as to the many benefits that have been derived from this method of scientific investigation. If so, they would give little heed to the false statements and hysterical imaginings that are periodically given out by small but vociferous opponents of this beneficent work. If the public once clearly understands that helpless, suffering children will be the class to suffer most, a positive and instant check will be administered to those who aim to stop the most fruitful advance in scientific medicine. At present, a few ill-balanced people seem to derive a cheap and easy glow of self-satisfied altruism by exaggerating the discomforts of animals who are being studied for the good of the human race.

The object of this paper is to show what animal experimentation has actually done for children. Let us substitute real facts for morbid and exaggerated fancies. Let us weigh the relative importance of a child's suffering or life against the discomfort and even occasional suffering of a dog. This is directly pertinent, for, in a last analysis, the defenceless child will have to pay the principal penalty if the advances in treatment brought about by animal experimentation are to be retarded or checked. A large part of all sickness occurs among children. The period of growth is one of great physiological energy, and pathological changes are often only an index of an overstrained physiological activity. Besides this, young protoplasm is irritable and favors the development of germs of all kinds. The victims of microbic diseases are chiefly the young. It is evident that the complete understanding and treatment of disease at this period assume the greatest importance, and anything interfering with such beneficent work may have the gravest consequences. It thus becomes a question of morals as well as medicine.

A brief review of some of its brilliant accomplishments will serve to emphasize the value of animal experimentation for children:

DIPHTHERIA

The most overwhelming proof of the value of a specific treatment is seen in connection with antitoxin in diphtheria. Before the intro-

duction and use of antitoxin in 1895, diphtheria could truthfully be called one of the greatest scourges of childhood. The death rate began to fall all over the civilized world with its increasing employment.

The following table, quoted from Keen, gives the official reports of the mortality from diphtheria for every 100,000 inhabitants in certain American and European cities before the use of antitoxin and after its employment had become general:

TABLE OF MORTALITY FROM DIPHTHERIA

	Per 100,000 Inhabitants 1894	1905
New York (Manhattan)	158	38
Philadelphia	128	32
Baltimore	50	20
Boston	180	22
Brooklyn	173	43
Pittsburgh	64	26
London	66	12.2
Paris	40	6
Vienna	114	19

Later on, Dr. Park in a study of the average death rate from diphtheria in 19 large cities of the world in 1893 shows it to have been slightly over 80 per 100,000; in 1895, when the antitoxin treatment was introduced it began to fall, and by 1907, when antitoxin was generally employed, the rate had dropped to 17 per 100,000.

In the London hospitals the mortality has been reduced from 29 per cent. to about 10 per cent. The same is true of other large hospitals of the world.

These studies extending over widely diverse localities and long periods of time do away with such possible errors as varying severities of epidemics or chance local conditions.

Not only has the death rate been much lowered, but the severity of the disease and its complications have been marvellously changed for the better. Perhaps this is best seen in the great diminution of the fatal and agonizing croup cases, where the false membrane descends into the windpipe and causes death by slow strangulation. We wish those who are trying to throttle scientific research would witness the awful struggle of a child dying from diphtheritic croup. Fortunately even physicians are now seldom forced to go through such an ordeal, owing to the beneficent results of a treatment directly inaugurated as a result of animal research. At the Willard Parker Hospital, even the late and neglected cases of croup that have not had the remedy before admission, after a large, though belated dose of antitoxin now very rarely die from strangulation. If they succumb to other complications, they are at least mercifully spared the torture of prolonged strangling. Before anti-

toxin days, two thirds of the croup cases that were tubed died at this hospital; now three quarters are saved. It is hard to realize what such figures actually mean. In the years preceding the discovery of the germ that causes diphtheria and the working out of its antidote, among the cases reported as dying from diphtheria, more than 75 per cent. were attributed to diphtheria of the windpipe.

Antitoxin, when early and properly given, will not only cure in a majority of cases but likewise immunize those closely exposed to the infection of the disease. Over 35,000 cases were thus treated by the New York Board of Health without any serious sequel.

Cerebro-Spinal Meningitis

One of the most fatal and distressing diseases, confined largely to children, is epidemic and sporadic cerebro-spinal meningitis. Before the working out of the anti-meningitis serum by careful, scientific experimentation on animals, there was no method of preventing the growth, and appalling effects of the meningococci that caused the disease. Now we have a serum that not only directly destroys or inhibits the growth of the germs, but also indirectly acts by stimulating the white blood cells to overcome the germs. At the same time a neutralizing action is exerted on the soluble and diffusible poisons that are secreted by the deadly meningococci. As a result, not only has the mortality been greatly lowered, but the severe symptoms and crippling complications have been most favorably influenced. The lowest mortality before the serum treatment ran from about 50 per cent. in sporadic cases to 75 per cent. in the epidemic form in different parts of the world. When the serum is now given by spinal puncture, the mortality drops to about 25 per cent. or even lower. If the serum is given early in the disease, the altered mortality is still more remarkable. The following table quoted by Dunn from the studies of Dopter shows this feature:

Mortality in Epidemic Meningitis under Serum Treatment

Cases Analyzed According to Period of Injection

	Flexner, Per Cent.	Netter, Per Cent.	Dopter, Per Cent.
First to third day	14.9	7.14	8.2
Fourth to seventh day	22.0	11.1	14.4
Later than seventh day	36.4	23.5	24.1

In cases that recover, the serum treatment not only shortens the duration of the disease—sometimes by several weeks—but lessens the chances of the terribly destructive sequelae, such as hydrocephalus, blindness and deafness.

Tuberculosis

While tuberculosis is a disease of all ages, its ravages are peculiar and widespread at the beginning of life. Children contribute their fair share of the awful record of one seventh of all the deaths in the world. Certain peculiarities of tuberculous manifestations in early life, such as the special involvement of lymph glands, bones, joints and peritoneum, rather than a limitation to the lung, have made the disease an interesting and hopeful study at this time. In order to successfully treat the condition, early recognition, before much destruction of tissue has taken place, is imperative. Early diagnosis, by means of inoculation, means a successful cure in a large proportion of cases. Hump-backed children, from tuberculosis of the spine, and permanent lameness from hip-joint disease, are rapidly becoming misfortunes of the past. Not only the way in which tubercle bacilli act in various tissues, but the methods of their transmission, are now known, thanks to animal experimentation. The knowledge of its spread by meat and milk has led to careful inspection of carcasses and an improvement and cleaning up of the milk supply in large areas of country by commissions and municipalities. The whole tuberculosis crusade, in which children are so largely the beneficiaries, would have been impossible without the use of rabbits and guinea pigs. The communicability of tuberculosis has thus been proven and efficient steps taken to prevent its spread. The treatment by abundant fresh air, sunlight and forced nutrition has naturally followed a better understanding of the disease. Seaside and mountain sanitoria, that are now so successfully treating the various forms of bone and gland tuberculosis in children, are but the end products of demonstrations that started in animal experimentation. Trudeau with his series of inoculated rabbits, keeping some in the open air with full nourishment that recovered, while those that were confined and underfed died, started the ideas that have had such fruitful results. In a period of twenty years, the death rate from tuberculosis in New York was reduced approximately forty per cent., and in Boston fifty-five per cent. This means the escape of hundreds of children from death or permanent disability.

Finally, a most hopeful result of animal study has shown that tuberculosis is not inherited. Thus has been removed the hopelessness that went with such a belief as regards the child. A knowledge that this dreaded disease is usually preventable and often curable acts as a stimulus to renewed and successful efforts for its final elimination.

Cretinism

The scant relief possible for most forms of idiocy is well known to both physicians and teachers. In recent years one kind of mental de-

fect has been explained and largely cured by a knowledge of the internal secretion of the thyroid gland. Formerly these cases were doomed to remain semi-imbeciles. They were repulsive in appearance, with stunted growth, facial blankness, tongue protruding from half-open mouth, trunk large with pendulous abdomen and short stumpy limbs. A dull, apathetic mentality was always in evidence. An implantation of the thryoid in the abdominal cavity of dogs by Schiff showed that this gland would functionate even after its removal or absence from its normal location. From this it was but a step to demonstrate that by administering an extract of the thyroid gland by the mouth, the symptoms due to its abnormal absence in the child would be removed. The arrested, perverted growth and mental dulness due directly to the absence of this important internal secretion can thus be easily corrected by giving the dry extract from the thyroid of an animal. A whole class of hopeless defectives has thus been rehabilitated.

Hydrophobia

This fearful disease, produced by the bite of a rabid animal, is one to which children are peculiarly disposed on account of their close association with domestic animals and their lack of judgment in failing to recognize sickness or distemper among them. Just here can well be shown the disastrous results of some of the efforts of those peculiar people who suffer from "Zoophil psychosis." According to Frothingham there were but 38 rabid dogs in England in 1892, but at this time the authorities removed the "cruel muzzle" owing to an agitation by the "dog lovers." As a result, during the next five years 1,602 dogs, as well as many other animals, and 51 human beings died from this agonizing disease. Even if proper means of prevention are not enforced and individuals are bitten by rabid animals, the mortality can now be very largely reduced. The Pasteur treatment has already lowered the death rate from between 6 per cent. and 14 per cent. to well under 1 per cent. This is true all over the world. Even the dogs, as well as children and adults, have profited by Pasteur's efforts at stamping out hydrophobia.

Vaccination

The prevention and change in the severity of small-pox by vaccination have been of largest benefit to children, as this loathesome disease is especially fatal and disfiguring at this time. Of 3,164 deaths in the great Montreal epidemic, 85 per cent. were in children under ten years. When vaccination is performed in infancy, the disease is prevented during the period of growth or so altered as to be innocuous. Early vaccination has completely changed the character and age period of small-pox: it was formerly so essentially a child's disease as to be called

"child pox." Rotch reports that during fifteen years no deaths from smallpox occurred in Boston in children who had been vaccinated under five years of age, while during the same time the mortality in the unvaccinated was 75 per cent. Similar conditions have been noted in other centers. It is hard to realize what overwhelming calamities were once caused by this fearful disease. Smallpox has now been practically stamped out in civilized countries by vaccination, yet it has been estimated that 60,000,000 died from this loathsome affection in Europe during the eighteenth century, and multitudes who did not die were permanently scarred and mutilated. The reign of destruction and death accompanying this disease continued until Jenner's great discovery in 1796. In Germany, where a compulsory vaccination and revaccination law has been enforced, there has not been an epidemic of small-pox for thirty-five years, although adjacent countries, not so protected, have had numbers of epidemics.

In the present discussion, it is interesting to note that a lower death rate from small-pox has been largely confined to children as they are so generally vaccinated. After the first decade, the protection is apt to wane and revaccination is required for full safety. The last objection to vaccination—the possible induction of other diseases—has now been completely removed by experiments on calves which shows that small-pox virus may be converted into a protective but innocuous vaccine virus by being transmitted through several bovine generations. Calf vaccination thus provides an adequate amount of virus that is safe because produced under careful scientific oversight of an animal fully protected from any disease or outside contamination.

While in the above-mentioned diseases the preponderating benefits in treatment have accrued to children, there are others in which the child shares with the adult in the advances derived from animal experimentation.

Malaria

Malaria, to which children are very susceptible, has been made largely a preventable disease by a study of the mosquito carrier, its breeding places and natural history, and by inoculation experiments on animals and man. It was proven by Italian observers that the mosquito disseminates bird malaria in the same manner as in the human subject. The final upshot of these investigations has been that large tracts of hitherto waste and dangerous land have been rendered safe and productive. A widespread cause of debilitating sickness, and even of death, has thus been removed. In such areas, the saddest sight has been the stunted, anemic children, with enlarged livers and spleens, the evidences of chronic malarial poisoning that can now be obviated by putting modern knowledge into effect.

The benefits of vaccination against typhoid fever are shared by children with adults, and the tests for the speedy recognition of tuberculosis and syphilis have given brilliant results by allowing early and successful treatment. It has been ignorantly or maliciously stated that these diseases may be induced by these tests, whereas such an accident is rendered impossible by the preliminary destruction of the living virus. Most of these charges are made by those having a ludicrous ignorance of the most elementary facts of biology.

In many cases, the destructive and prolonged poisoning of syphilis can be eradicated by a few doses of Salvarsan followed by the older alterative treatment, and thereby a hereditary taint completely removed. It is thus possible to protect innocent mothers and unborn or recently born infants.

Surgical Conditions

It is hardly necessary to state that children have derived their full share in the inestimable benefits that have followed aseptic and antiseptic surgery. Septicemia and pyemia are prevented and frequently cured. Cavities of the body formerly out of reach of surgical aid are now fearlessly explored and life thus saved. As an example, the various obstructions of the bowel peculiar to children are cured in a large proportions of cases. In former times death usually ensued in such conditions, as both physician and surgeon feared the large mortality that followed the opening of the abdomen. Even very young infants are now successfully operated upon for this grave condition. Certain forms of peritonitis are cured by simply opening the abdomen.

Recently, bone grafting, that promises brilliant results in straightening crooked backs and other bony deformities in children, has been successfully tried as a result of previous experiments on animals.

Profuse and uncontrollable hemorrhages in the newly-born, formerly fatal, are now saved by transfusion, which was first studied and the technique perfected by vessel suturing in the lower animals. Practically the whole realm of surgical accidents and diseases in children has been benefited and illuminated, directly and indirectly, as a result of animal experimentation. We must not forget to mention, in this connection, how anti-tetanus serum has prevented lockjaw after certain jagged wounds. It has thus helped to take away some of the horror from the frequent accidents to children in the cherished, but undesirable, Fourth of July celebrations.

If such great and beneficent work has already been accomplished in a few years, it is safe to prophesy more certain and brilliant results in the future. Scientific men have perfected their knowledge and technique and are fast conquering nature's secrets. There is no foretelling to what extent disease can be overcome by persisting in the present fruitful

methods. Already infantile paralysis is being hopefully studied as to cause and consequent cure. The same can be said of other crippling and fatal diseases.

The lay public must be taught to appreciate and encourage the devoted men who are patiently toiling in laboratory and clinic, frequently at the risk of their own health or life, to discover the secrets of disease and thereby conserve both health and life in others. They are the true apostles of the modern world. Our civilization owes them a debt of gratitude that can never be paid. If they are to be harried and obstructed in their fruitful work, it will be at the risk of ending all scientific advance. Any community with such narrow vision as to allow such obstruction will stand convicted by the judgment of an enlightened humanity.

EUROPE'S DYNASTIC SLAUGHTER HOUSE

By WILLIAM J. ROE

THUS, half a century ago, he forecasted what is now happening on the other side of the Atlantic, who was perhaps America's most subtle reasoner. He is commonly classed as a poet—this man, Walt Whitman—lauded as such, reviled as such. He was really a prophet; though, as it is presumed to be well known, "High Criticism" in final analysis declares that the words prophet and poet are synonyms.

The younger Scipio Africanus has left an account of his observations of a great battlefield; of the battle fought between Syfax and Hasdrubal, the Carthaginian, and Massinissa, an ally of Rome. Scipio chanced to be present in Africa when this battle was fought, and was able to witness every manoeuvre from a height near the field of conflict. From the account thus transmitted to modern times has come the adage that "Onlookers see most of the game."

Manifestly, however, Scipio's observations would have served little if he had been a common peasant or mere civilian. He was able to comprehend the tactical movements and their relations to the strategy of the contending forces solely because his military training enabled him to understand the meaning of isolated movements and their bearing upon the final result.

While strategic principles remain to-day in precisely the same condition that they were at the beginning of the last Punic war, it is of course no longer possible for a neutral observer to station himself upon a height and overlook a battlefield. The numbers engaged are too great, the field far too vast, the range of projectiles too extended, the obscurity of the "battle cloud" too dense. For data of military events the reporter, critic and interpreter is compelled to rely upon reports, official or otherwise, and these always more or less romantic, or actually mendacious, and usually garbled, censored out of all correct perspective in the endeavor to deceive both friend and foe, to meet supposed military or political expediencies.

The scope of the observer of military operations at the present day has not only been immensely broadened, but wholly altered in character. The critic of strategical combinations and tactical movements must now be equipped with information undreamed of in the days of the Romans and Carthaginians, dreamed of doubtless, but as yet subsisting only in dreams during the Napoleonic wars, and which for virtually the first

Area of murder-plots of thrones, with scent left yet of wars and scaffolds everywhere.

time in the long record of man's inhuman struggle with his fellow man, has become vitally essential.

To carry out the figure, the modern Scipio, viewing from a height in America the great war now waging in Europe (at present localized along the lines of the Aisne and Vistula) must be "expert" in a multitude of branches of knowledge, if he wishes to know accurately, either for his own satisfaction, or the worthier object of conveying information to others, with a view possibly to mitigating some existing horrors, or to avert needless calamities. Such an observer must possess a fairly complete theoretical knowledge of the science and art of war. He must be informed as to topographic conditions, not only at the immediate scene of combat, but in all directions wherever new lines of offense or defense could be established. He must know thoroughly conditions of transportation, provisioning, armaments, offensive and defensive, powers, ranges, etc., of ordnance and small arms of combatants, and not only available present supplies, but resources, near and remote, of every possible kind. And his knowledge must take into account in this day of novelty everywhere of sea-forces and air-forces, an approximation at least to familiarity with all recent devices of mines, torpedoes, submarines, etc., and a sufficient working knowledge of all varieties of warcraft and scout-craft of the air.

But besides all these informing utensils of elementary "militarism," the onlooker must have an intimate acquaintance with the general trend of history, not only of warfare, but of social, financial and political conditions, and besides he must be able to pick out unerringly the true meaning of those past events (like points on an orbit to the astronomer) which have gone to the influencing of those of to-day. But above all else this onlooker's acquaintance with the basic actuating and initiating function (commonly called "common sense") of human nature must be impregnable. This is in fact the chief ingredient in the puddler's flux, which (while individual actions elude all attempts at prophecy) give value to reasoning, and may be safely reckoned upon to provide trustworthy data for foreknowledge.

Viewing then the vast field of conflict now raging in Europe it is evident that bases for ascertaining the inevitable final resultant must be sought—not in any temporary incidents or conditions, nor from segmental logic, however well founded, but upon the data practically axiomatic—components equivalent in force and value to those of Euclid.

The inventor and constructor of a machine, which he is confident is entirely capable of performing its work—gratifying the vanity of the projector, adding to or making his fortune—is always restless, uneasy and dissatisfied until he has tested that machine in action.

This axiom of human nature applies to any machine whatever, es-

pecially to a novelty, and includes the vast, complicated, and diversely constituted mechanism of "blood and iron" which goes to the making of a standing army. The military system of the German empire was such a machine. The opportunity came to test its efficient action (fortune adding or making, or merely defending, it is all one) and immediately the opportunity was availed of. Germany was prepared to mobolize and she did mobolize, admirably and with wonderful celerity. She was prepared to attack, and doubtless with no thought, or but trifling thought of failure or even serious impending, she did attack. Owing to the rather unexpected and stubborn resistance of Belgium, and the entirely unexpected and most masterly strategy, credited, and it is probably correctly so, to General Joffre, the dynamics of offense—the sudden and overwhelming crushing of France—failed. The static energy still remains, as yet unimpaired, capable perhaps, though that is unlikely, of further offensive movement on a large scale.

What has been said of Germany's utilization of her wonderful war organization must not be taken as solely applying to the German empire. Certainly to debit the Kaiser, or the "ruling military class" or the mass of the Germanic peoples with a deliberate desire to incite war, is to assume an intention of murder-plotting which did not exist. France, as well as Germany, possessed a highly organized and (as has been amply proved in the field) effective military machine, which she would have employed with equal readiness aggressively, but for the ever-present doubt as to whether it would work in practise. France sighed as she thought of the alienated provinces, contemplated the preponderance of power of the neighbor who had filched them, exorting the billion of loot, sighed, shook her head with a doleful, *C'est trop dur,* and was at least partially consoled by the reflection, not that she felt herself more moral than Germany, but that "the inevitable was not debatable."

We come now to a candid, impartial, and unprejudiced consideration of another and quite different phase of the continental conflict.

Rivals in any line of activity are never very scrupulous as to utilizing—or sometimes even creating—opportunities to cripple, or even to destroy each other. This is especially cognizable in business affairs (from corner-groceries to empires). But a rival, however unscrupulous, feels in these modern days when public opinion is a force, a compulsion (called by some "moral") to defer to that force. It is incumbent upon him to find a pretext, real if possible, certainly plausible, for his crippling or destruction.

Russia, for the chances of an open Bosphorus and a permanent-ice-free port welcomed the challenge to arms, not with very great alacrity, but still it was welcome. France, because of possibilities that the future might disclose of reclaiming the lost provinces of Alsace-Lorraine,

was not unwilling to accept the challenge. And this challenge that Russia welcomed and France accepted not unwillingly, was responded to at once by Great Britain, cordially and greedily. For many years Germany had been insidiously encroaching upon Britain's supremacy in commerce—making and selling more available goods, and more and more displacing her rival in the markets of the world. To cripple or to destroy German commercial rivalry was desirable.

Of this desire, however strong it may have been, not a hint is to be found in any official paper or utterance. On the contrary, the so-called "white papers" and those of other colors, disclose an endeavor, even most strenuous effort, to avert war, and that only the high ethical ground of upholding the validity and obligation of treaties, and especially the integrity of the guaranteed neutrality of Belgium, precipitated war. These endeavors and efforts prove either the pacific incentives of individuals of the British foreign office, or the marvels of adroitness of publicists in power seeking to clothe a pretext in a garb of immaculate plausibility, probably both.

One of the wise fables of Æsop relates that a hound, reproached that his quarry, the hare, had outstripped him, replied that it was "one thing to be running for your dinner, and another for your life." The idea embodied in this fable may have had some place in bringing on the present war; it certainly has the very first place when questions are raised concerning the return of peace and the conditions of peace.

As to affixing "scientifically" (that is with knowledge) the responsibility for the terrible conditions prevailing, the factors are far too numerous and complex. The claim of the Allies of having had war thrust upon them is well taken; it was thrust upon them. The claim of Germany that she was forced to assume the "offensive-defensive"—that she fights for self preservation—is also well taken. On the surface, the seeds of war were sown when M. Berchtold, in the name of Austro-Hungarian dignity, exasperated beyond endurance by murder-plots in Servia, culminating in the assassination of Prince Ferdinand in Bosnia, in the attempt to exact a righteous reparation, overstepped a legitimate right of sovereignty. However guilty—or however much a conniver at guilt—Servia's moral right to resist an assault upon her independence can not be questioned. She went far enough in way of concession.

Several problems now present themselves which perhaps the future may solve, chief among which is found this: Would Austria have taken so strong a ground without definite assurance of support from the north? Whatever solution to this may finally be uncovered, and to other problems of like order, the certainty of responsibility goes further back, being found in a gross departure from the righteousness that should exalt a nation. By this is meant that the holding of Bosnia and the Slavic peoples wherever they dwelt under Austrian rule was wrong—

worse than wrong, it was folly. Imagine the clear-headed wisdom, which is of itself grandeur, that in the settlement of Balkan frontiers, with willingness and cordiality had furthered the cause of Servian nationality, not "grudgingly or of necessity" declined territorial aggression, and permitted—nay, invited Servia to a sea-port on the Adriatic.

Such highmindedness was not to have been expected of ruthless nationalism, as yet feudal, medieval, neither civilized nor Christian. What really happened was the outcome of age-old precedent, exponent of piracy and brigandage, that "they should take who have the power, and they shall keep who can." Such an action would (who for an instant doubts it?) have averted the war. Idealistic? Yes. Sentimental? Yes. But it would have been something else, something better by far than idealism or sentiment—it would have been clever—what we rude Yankees call "smart." In general it may be said that it is better to be clever than to be good, for cleverness includes morality; but "though thou shouldst bray a fool in a mortar yet will not his foolishness depart from him." There are all kinds of fools, but none so foolish as the fool who is sure of wisdom founded upon power, and not "broad-based upon the peoples' will."

Returning to the subject of a correct forecast of the future, undoubtedly neither Russia nor France has at stake very much more than losses—land, money and prestige. Though the ultimate success of German arms should be complete, neither Russia nor France need fear any spoiliation that time and economy can not retrieve from the most ruthless enforcement of the right of conquest. Of course France would again have heavy damage exacted; but Germany would be willing enough to "cry quits" with her gigantic Slavic neighbor. Both nations are (to use the apt simile of Æsop) "running for their dinner" and no more. Permanently to annex further French provinces would merely embarrass Germany, and already she has enough discontented and hostile Slavs without adding to their number.

But between Germany and Great Britain the relations—present and prospective—are and will remain until a final settlement, vastly different. These nations are both fighting "for their lives." With them it is war *à l'outrance,* to end only in the destruction or humiliation of one. As to which one this must inevitably be it needs hardly any "gift of prophecy" to forecast.

In considering the path and progress towards the inevitable, factors numerous, complex, and perplexing, crowd and jostle one another demanding recognition as important or conclusive. Current journalism is full of them, some occasionally suggestive, but mostly merely silly, being generally based upon partial, imperfect, or erroneous information, or upon prejudiced optimism. Just a few among many having real

relevancy, may be casually mentioned. The German war-ships, self-interned at the Kiel canal, may at any time prove a very active menace; much more probably than those Zeppelins, the very talk concerning which has thrown a chill to the heart of England. It was premature; the big Zeppelins are very vulnerable, rightly assailed, and—happily for English comfort—they realize it.

On the other side there lies the inviting coast of the former Danish province of Schleswig. Behind the Sylt the waters are shallow, but it would not be difficult to land an army there. In time something similar may be reckoned upon—a force, probably all British, with suitable ordnance, to advance upon the canal and its fortifications on the north, to demolish these at leisure, and afterwards try conclusions with the fleet, unless it had slipped out, warily into the Baltic or boldly into the North sea. This project of invasion is instanced, not as imminent, but rather a strong possibility of the future. Its efficacy is found in facilitating operations, in affording a third "face" of attack.

In considering the outcome the element of time is of course a very uncertain quantity. But time is an ally of the Allies, the most stanch, most certain and trustworthy ally. All told, Germany can perhaps count upon about one hundred millions actually or nominally loyal to her cause. Russia, Britain, and France combined can count upon at least six hundred million, with equal or greater confidence of loyalty. Germany is badly handicapped. The greater general intelligence of her population; its greater diffusion of freedom of thought; these in time will begin to ask questions, to urge demands.

During our civil war, a rude mountaineer was brought into camp as a prisoner somewhere in east Tennessee. At first surly, at last he softened. "Say!" said he to his guard, "what anyway is you-uns fightin' we-uns for?" If ignorance could be brought to put so admirable an enquiry, how much more likely—at the right time—the "psychological time," will intelligence!

Day after day, slowly the equality between opposing forces will be diminished, replaced by increments of preponderance of the Allies. The effective strength of numbers will slowly crumble on one side, slowly accumulate for power of offense on the other. The very successes of German arms point the way to her ultimate downfall. The day of the facile fall of the Vauban-planned fortifications of Antwerp, added to by every device of science and steel, was a great one for the cause of universal peace, far greater than anything effected by the Hague Tribunal, or by all the peace treaties ever signed. The meaning is—or ought to be—evident—that the day of armored defenses *as defenses* against the ponderous ordnance constructed by the Krupps is at an end. Even at this hour there are several object lessons to invite scrutiny, notably that Verdun continues impregnable, not because of its being invulnerable as

a bastioned work of the first class, but that the French burrowing in the ground are holding off the enemy to so great a distance that effective batteries can not be planted.

For many months the question of food supplies will not be pressing for the Germans. But in time this will bear its part in the final catastrophe, by adding to the distress that is certain to come. In times of peace the empire is almost—but not quite—self supporting. With war on both—or all—borders forbidding any considerable importation of provisions, the deficit greatly augmented by war's inevitable waste, will result in scarcity, eventually in localized deprivation or even a degree of actual famine.

How the end will come, or when it will come, is beyond all human foresight, or possibility of even approximate prediction. That it will come is certain. When at last—in a year, two years, or after many years, after incidents perhaps of horror beyond scrutiny or imagination —when Germany lies prostrate and defenseless, what then will happen?

Europe was once before similarly afflicted, similarly desolated. From first to last the history of the Parisian revolt against the excesses of the Bourbons, striking—as revolution often does—at the least excessive of them all, is before us. We know the rise of the plebeian, Bonaparte; his good work for French liberty; his misplaced advancement of French "glory," his futile "militarism," finally crushed by counter-militarism vaster in numbers. After Waterloo (or *La Belle Alliance*) the victorious allies of 1814 dictated at Paris terms that restored a system not a whit an improvement upon the past of Louis XVI., but which yet was compelled to accept or adopt improvements. Even with Napoleon at St. Helena, his work—because it advanced the cause of human freedom —lived and grew; it had life abiding in it.

This portentous precedent, with many others more remote, are before us. Guided by them alone it would not be difficult to approximate to the onerous and degrading terms which it has been the invariable habit of victory to impose—enormous money compensation, extending to virtual impoverishment, even the enforced elimination of the Hohenzollerns and the total dismemberment of the empire. That indemnities will be exacted in huge amounts, mortgaging the prosperity of the Germanic people for many decades, even generations, is hardly doubtful. The provinces of Alsace and Lorraine will naturally be restored, Russia will probably acquire whatever additional Slavic territory may seem to her desirable; and Belgium be recompensed for her loyalty and losses by donations of Luxemburg and of sufficient of Rhenish Prussia most amply to compensate her. That Schleswig and Holstein, filched from Denmark in 1864, may be restored is highly probable, of course under rigid guarantees of international usage of the Kiel canal. Italy's position is easier to define than her prospects to risk prophesying; to-day neutral

(because to fulfill her obligation of the "Triple Alliance" was too dangerous), to-morrow perhaps openly antagonistic to Germany (because satisfied that thus only can she share in the spoil), those sections of country known as Italy Unredeemed may become hers.

The Austro-Hungarian empire will suffer nationally even more than the states constituting the empire of Germany; but probably to the decided betterment of the several races. It is of course not impossible that partition of the monarchy may be averted by a separate peace, though Austria can hardly expect to retain intact her heterogeneous segments. The Balkan peninsula will again be remapped, and (provision being made for canalization of the Bosphorus and Dardanelles) Moslem rule at and near Constantinople will be replaced by a "zone" that self interest will respect, power cause to be respected, and a new and more equitable "balance" established in measurably stable equilibrium.

At the present time (mid-December, 1914) while the contending forces are locked in a life or death grapple on the west, and are swaying to and fro, now one having advantage, then another on the east, there are many good people, well-meaning people, appalled at the losses of life and waste of substance, who would seek to end the hideous horror by urging immediate pacification.

But to end the war now, even if it were possible, would be most deplorable. Doubtless to seem to advocate a continuance of bloodshed and destruction must to these people—"peace-at-any-price" people—appear wantonly cruel. Scanning the course of human progress, it is clearly to discern from remotest epochs incidents (lights shining in the darkness uncomprehended by the darkness) tending to ameliorate the unhappy conditions of the masses of men. It is not this generation alone, its sentiments and ideals, but all coming generations whose welfare and happiness it should be for men of to-day—actors and thinkers alike—to toil for and to plan for.

There is a current phrase, prated of for the most part ignorantly—"getting back to nature." Rightly understood the idea is admirable. But in final analysis, nature is indifferent, implacable, impartial, and so cruel. Nature cares nothing for individual lives, everything for life; nothing for men, all for man; nothing for artificial nations, all for races and for peoples.

Action and thought should emulate nature. In the terrific emergency now thrust upon the world, nothing should restrain us—no consideration of expediency, or even of temporary humanity—from holding fast and upholding firmly the ways and means that tend to the destruction of destruction, to establishing new and sure and safe guarantees. Fortifications of stone were found to be of no avail against the bombardment of the Columbiads and the Armstrongs and the Whitworths; re-

placed by bastions and scarps and turrets of steel, these also before the fire of colossal ordnance crumpled like parchment. In any new settlement or alignment shall nations be invited, encouraged or permitted once again to enter upon a ghastly rivalry of forces, to construct again so called defenses incalculably stronger, but destined in some future war to annihilation? Such a settlement is unthinkable; peace established at a prospect of cost to our coming race would indeed be cruelty.

Let us renew the query: when Germany lies prostrate and defenseless, what will happen? And let us add—not sentimentally or morally, but practically, and "scientifically"—what ought to happen? To many Americans, probably to a majority even of those not ill informed as to matters of negotiation in the early days of our national existence, it appeared singular that Great Britain consented with so little show of reluctance (it was in fact with suppressed alacrity) to modify so seriously the old Clayton-Bulwer treaty, by which modification we gained a very practical control of the interoceanic waterway. In few words it was because Britain's far-sighted diplomacy easily recognized in the United States a prospect of profitable alliance, unwritten and un-"entangling" though it were, by which the mistress of the seas shifted upon America (on account of our "Monroe doctrine") the expensive and disagreeable duty of policing the Western Hemisphere. With quiet and well-founded confidence immediately after the ratification of this treaty, Great Britain withdrew her war ships from American waters. The value of this treaty—this "scrap of paper,"—lay not at all in any especial reliance by Great Britain upon American national righteousness or friendliness, but upon that which in every exigency of human affairs, with nations and individuals alike, is more trustworthy than all professions of friendship, than all righteousness—enlightened self interest, mutual benefit.

Much has been written, and with very great ability and high sense of the obligation of "ethical values," concerning the establishment hereafter of an international "posse comitatus," to the end of enforcing peaceful relations, and of compelling acquiescence in the decrees of an international court of arbitration. The weakness of such an arrangement—most admirable if it could be assured in perpetuity—lies in this: that its permanence would depend not solely upon mutuality, but largely upon comity, upon a "scrap of paper," a contract voidable at any moment by one or the other of the "high contracting powers."

It is a military axiom that "one bad general is better than a dozen good ones," and an axiom of very practical business that for utility and prompt acceptance a novel invention must "utilize already existing plants." These two sayings, axiomatic or merely aphoristic, as one chooses to regard them, may find unexpected, but very practical application in the future, near or remote. It is by no means impossible that

in the inevitable new alignment of European influence and power, a doctrine of Great British diplomacy may arise akin to that so notorious as of Monroe. It would mean a policy of "policing" applied to the eastern continent, and its similarity to our own benevolent protectorate would be pronounced, since very recently the United States has been joined by the strong and self-sustaining republics of South America, Brazil, Chile, and the Argentine. In effect we have become merely *primus inter pares* on this side of the Atlantic, and that would be the position of Britain upon the other.

Because of her vastly preponderant sea-power Great Britain would be able to enforce virtually whatever police authority she desired to assume. Her assumption of permanent leadership, certain to be resented and opposed if by a premature and unnatural patching up of amicable relations, the old antagonistic order were resumed, would be concurred in, not only by the partners of the present alliance, but by the feebler nations, who would further it cordially, for economy, for safety, for practicability; but only in the event of the establishment of a new order founded upon an enduring equity.

How then will it be possible and practicable to ensure equity? Eventually upon Great Britain alone will rest the supreme responsibility. In conjunction with her allies the rights, obligations, and privileges of nations and races will be readjusted on the European continent; but her interest extends, and her power for good or evil, throughout the world. In the past (as history amply testifies) British greed has seldom been thwarted very seriously by British sentiment. Either by conquest or artifice she has proceeded slowly but surely in the process of "benevolent assimilation" of alien and often unwilling peoples. At the time of the conclusion of the present war numerous and plausible excuses will not be lacking for a continuance of this deplorable policy. Such a course, not unjustifiable as applied—in the interests of civilization—to barbaric tribes, would be wholly inapplicable and inequitable arbitrarily enforced against Germany's colonies. Most certainly the extension of dominion by right of conquest over East and West Africa would dissipate at once ideas of enduring equity conditioning any leadership of a "posse comitatus." No movement towards a new and true order of national and racial relations will be possible unless from the very first any selfish policy of spoliation is repudiated.

Apart from those highly proper exactions in way of repayment for injury and destruction (as to which the common consent of mankind will be freely accorded) no excessive or wanton tribute should be imposed upon the German people. Whatever form of government, retained, accepted, or set up externally or internally, by or for Germany, the German people should be encouraged to restore as speedily as possible for themselves their own prosperity.

Heretofore in the world's history the rule of the right of conquest has been indubitable: to the victors all; to the vanquished nothing, or nothing not conceded as a gratuity. In lieu of former tyrannous exactions, it will be for Great Britain to stand steadfast lest floodgates of rapacity open wide; to initiate a new order, not as ethical, but as equitable, correcting the cruel law of might and of greed, by the law of right, not because it is good, but because it is great.

It will be only by the unquestioned forbearance of the West that the East can be effectually restrained. There lies the future's peril. The wisdom of the first Napoleon was not astray in declaring that Europe was destined to become "all Republican or all Cossack." It will be for men "of good will," not apathetically to await fiats of Omnipotence concerning peace on earth, but rather to make and enforce peace themselves in the only way by which permanent peace is possible.

Instances of historical generosity (so bestial is the natural man) are rare indeed. Of the few of record the following may be briefly mentioned: After the defeat of Pompey's army at Pharsalia Julius Caesar, instead of ordering a general massacre or enslaving of the conquered, issued an order according to every man of his own forces the *privilege* of ransoming one of the enemy. It was thus that Julius made himself Caesar. After the fall of La Rochelle, the English knights taken prisoners and without means to ransom themselves, were sent under a flag of truce home to England and there set free. The English, not to be outdone, chivalrously restored to the French an equal number of captive knights. From this incident came the custom of exchange of prisoners, so greatly ameliorating war's horrors.

The interchange of kindly courtesies between Grant and Lee after Appomattox furnishes an American instance of the practical value of generous actions. And another deserves recording: when the great-hearted, wise-minded Lincoln, reproaching the vindictive of his cabinet who stigmatized playing the delightful air of "Dixie" as "treasonable," said: "Not so; we captured that tune with the other effects of the 'Lost Cause.'"

In the coming readjustment of European affairs, armaments, and frontiers, America will surely be called upon as counsellor or arbitrator. Her opportunity will be splendid. Already into American hands in every capital of the contending nations antagonistic interests have been committed. These, our envoys—ambassadors, ministers, and chargés—should be of one mind as to the spirit and purpose of mediation when the time for mediation shall come.

Doubtless it is more difficult for the onlooker to judge justly as to events and policies of his own country and time than of activities of which he is merely a spectator. At this very hour discussion is rampant concerning the course that the United States should assume to

protect its territory against possible foreign aggression. Some—so-called "Militarists"—would advocate a huge standing army; others, actuated by motives of Christian principle, find in complete disarmament, the surest defense. As to our duty—having due regard to both practicality and spirituality—perhaps a few homely illustrations may not be out of place.

Imagine a devoted missionary left alone in a land peopled by cannibal savages. Doubtless Christ-like peaceableness, gentleness, and good will, together with self-possession, and perhaps a trifle of this world's craft and subtlety, might avert assault, and secure a hearing for sound doctrine. And yet (as even the most amiable "peace-at-any-price" person will admit) immunity would depend largely upon other factors, say, the degree of hunger of the cannibals and the edibleness of the missionary.

The situation is not dissimilar when an ordinary citizen finds himself in the midst of a gang of toughs in a "boom town" or in a slum of a city. Good intentions alone can hardly be reckoned upon for protection. Let such a man beware that his dress does not violate local conventions; let him beware of any "swagger," or a hint of superiority. If he has no real errand or "call" to that neighborhood, he had better simulate one, for there is nothing a barbarian so resents as unwarranted curiosity and intrusion.

As to armament, it may be admitted that often (under circumstances above instanced) defenselessness might be the best defense; even the barbarian possesses an intuitive chivalry. Certainly the display of a weapon would irritate, as much, but no more, than a truculent manner. But it must be remembered that there is a kind of armament that no one thinks of resenting, the natural kind, undoubted fine muscular development, a carriage of body and glance of eye, denoting neither timidity nor a challenge. If in addition the citizen can call to his aid a reputation for force and courage, if he is known as "bruiser," he may be said to be invincible.

As with the individual, so is it with the nation. We talk glibly of "International Law," as if such a thing existed. There is a body of precepts, practises, and precedents, which have won a general toleration and partial acceptance, but this is custom, not legality. Law (to be worth anything) is a rule of action with a penalty for violation—a penalty enforceable. In establishing the Hague tribunal an attempt was made to legalize the peaceful consensus of opinion of civilization. In Germany's violation of Belgium's neutrality, the total failure of pacific contracts is found and the futility of a covenant not backed by overwhelming force. That Germany asserts a vital necessity serves only to emphasize the truth that "necessity knows no law."

It is for our military men, for the peace-lovers, legislators, and all

good citizens, not to demand literal interpretation of these illustrations, but to think them out, "each for himself and not for the other." Whether with our insular possessions we have intruded insolently; whether in our Monroe doctrine we have "swaggered"; these are possibly debatable questions. I do not say that our altruism will remain unrewarded by conversion of savages; but it is not yet definitely decided that the cannibals are not land-hungry, and it is very certain that the missionary is very, very edible.

The question of our national defending, not for aggression, but to prevent aggression, on sea and land, beneath the seas and in the air; this needs to be thought out and legislated out, and acted out. Upon this however full reliance may be placed: that until our great cities can dispense with an adequate police force, the nation will require the defence which trained defenders alone can insure.

Some of us, especially as to activities and non-activities in Mexico, have openly sneered at the administration's policy of prudence—of so-called "watchful waiting," candor compels confession that for one having had a military training, and withal having the strongest admiration for "strenuous" action, to refrain would have been difficult indeed. Nevertheless, in view of what is happening in Europe, the feeling can not be repressed that this policy will find justification, not in premature urgency as to our good offices, but when the day comes, as it surely will come, for an umpire, disinterested, unvexed and unhampered by affinity or collusion, as a sincere friend to all nations and to humanity, to urge and to demand guarantees of an enduring peace.

TRAINING FOR ACTION

By H. W. FARWELL
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EDUCATION is properly preparation for service. That man who enters upon his work with a poor idea of what is required of him is at once seriously handicapped and often prevented from reaching a goal which he hopes to reach, and strives to attain, sometimes with an enormous waste of energy. Much praise should be given to training which seeks to give high ideals and broad outlook, but surely something must be spoken for effort to make clear the means of attainment of a laudable ambition based on high ideals and broad outlook.

We know well the value of fundamental principles. We spend much time to ascertain what things are essential. We try to bring to younger minds the best of the results of continual analysis; yet on one point there seems to be very little effort made to make more certain the accomplishment of tasks whose essential features are readily traced to underlying principles. One of the greatest things about any work is its final solution, accomplishment or completion. The conception of a work of art, of a suspension bridge, of a transportation system, is not for all of us. There have never been too many "men of ideas." But ideas arise from imagination and only too often the plan goes awry before the final realization. The "man of ideas" needs a man with a power to accomplish.

There seems to be prevalent the notion that executive ability is a gift from nature, made to comparatively few in a generation. When one of these endowed individuals is thrust into a position of responsibility, his talent appears and success follows almost of necessity. Since this ability is rare, much time is lost in finding a man who possesses it; meanwhile, a great injustice is done to those dependent upon the executive. Such a point of view can hardly be considered fair even to the average man, for not all positions demand the highest order of executive ability.

Other people apparently assume that executive ability is a characteristic of all men, that any one in a position of responsibility, for which he has the requisite training in principles and methods, will be able to accomplish as much as any one else. How fallacious is this assumption may be quickly seen by considering the varied accomplishments of, let us say, our representatives in congress.

Executive ability is a gift from nature, to be sure, and possessed by every man, but in the same way that each man has talent for music

or for mathematics. Some have five talents and some have one. And no one would expect a young man to earn his living by means of his native musical ability without first training him to make full use of that ability. An aptitude for figures does not mean that the possessor does not need to study mathematics. That is probably what he should study most diligently. Furthermore, the discovery of nature's gifts of musical ability is not postponed until the talent is atrophied. The fond parent seeks it early and eagerly develops even a minute resemblance of talent. Why, then, is it so frequent that young men go out from school or college with no dream of their own potentialities as executives?

Specific illustrations are perhaps unnecessary, though one or two may add force to the argument. A young man, after a fine record for scholarship in high school, took up a course of scientific study in college. He found the field so alluring that he went on to a university course, taking his degree of Doctor of Philosophy with a careful and thorough research requiring a marvelous technique of manipulation. So promising was his ability that a large corporation at once engaged him to continue his work in a direction which meant much for the future of the concern. The young man found himself suddenly in an embarrassing situation. No longer was it necessary for him to spend hours searching the scientific literature for the history of a certain process; he need only direct an assistant to do this for him. The tedious watching for the results of an experiment was transferred to a subordinate. The careful manipulation of materials could be taught to an eager stripling whose idea of the significance of his work was at best vague and narrow. In the meantime the young scientist found that the direction in which he was inclined was not that of the executive, but that of the student. In a word, his education had not prepared him for the work expected of him.

A rude awakening came for another young man who had recently taken the degree of Civil Engineer. He could make long computations of stresses in girders for steel work, he could lay out beautiful curves for a railway line. but all his years of college had not trained him in the very practical problem of keeping busy and happy a party of sixty additions to the melting pot, knights of the pick and shovel. Where do the text-books state that a young engineer should never allow such an occasion to arise that one of his dusky foremen calls him by the short and ugly name, or that, the occasion having arisen, he should promptly apply a sedative by means of a convenient pickaxe handle if he wishes to maintain his self-respect and his job?

It has been claimed that plenty of opportunity is already given in school and college for the development of executive ability, both in the curriculum and in outside activities, that those men who wish training

in the management of affairs, in the handling of men, in the planning of large enterprises, have, in a small way, every chance in college that the later life affords. This is apparently true, but the real situation is quite different.

In extra-curricular interests the choice of undergraduate managers with all the rivalry of various clique-candidates has in the past called into play the methods of the ward politician rather than those of men of business ability. The system produced such woeful results, largely due to incompetence and ignorance, that of late the undergraduate managers have been themselves under the control of a man of tested value. The large opportunity has gone, sacrificed by the students themselves. In what remains, the chance is open for few comparatively, and here popularity still counts for more than real ability. At best it is work to be taken on in addition to the requirements of the curriculum, and this fact is in itself sufficient to restrain many of the most worthy from attempting more than they can do well. Further, the leaders of these activities must have time to spare for their duties, an immediate result of which is the elimination of all men who must earn their education as they go. Often these are the most in real need of the training for responsibility. And those students who carry outside work requiring business ability are generally found to be spending too large a portion of their time away from the work supposed to be of first importance.

What of the curriculum itself? In what way do the present courses of study lead a man to find himself in the particular field under discussion? More than one college president has admitted the shortcoming, sometimes on the ground that the training in college must of necessity be theoretical, sometimes that the development in the direction of affairs is new and that time is required for the readjustment. It is wrong to belittle the content of the courses offered for students to-day. The material is without question more accurate and of greater variety and amount than ever before, but, judging from the results, it does not sufficiently develop in men a very important side of their natures. They are not sufficiently acquainted with the actual working to produce results.

Perhaps the laboratories train students in the way of accurate analysis and systematic coordination. It is certain that there is opportunity for such education. A quotation from a recent laboratory manual will throw some light on the way in which this works out in practise.

> The forms for recording results and the outlines for computation have abundantly justified the wisdom of their insertion in the immense saving of time and energy to the busy instructor. While it has been urged by some that students readily and intuitively devise explicit, symmetrical and logical arrangements for their data and computations, such students have as yet entirely escaped our observation.

The obvious interpretation is that the authorities realize the great need of the student, but for one reason and another deliberately pass by the opportunity.

There is still much in the way of business management to be learned by the student who has his eyes open. But it must be confessed that most men are blind even to plainest of facts. The instruction is too indirect, and the operation of the plans are so smooth that it attracts no attention. The average student does not observe much of the carefully planned system which operates to give him his education; yet it would be well worth his careful study, as an example of organization.

Sometimes the beauty of a picture is lost by concentrating the attention on the technique of the artist. So, too, the teacher may fail to hold his class if he explains the method by which he commands attention. The indirect training can not be made the major part. It then loses all its value. There must be something direct and positive.

One can not overlook the existence of some very excellent schools for education in business administration, but these are not able to give to every college man what little he may need to discover within himself the ability for affairs which must in the end be developed in actual life itself. More institutions are quite unnecessary, for they would still leave the great mass of students as they are to-day. The need is for the revision of existing curricula to the end that the average student may at least know what business ability is, and whether or not he himself possesses it in small measure or in large.

DELUSIONS

By Dr. SHEPHERD IVORY FRANZ

GOVERNMENT HOSPITAL FOR THE INSANE

IT is well known that sensory stimuli are not always correctly appreciated, and that under certain conditions errors of judgment are made. These errors of perception which are not infrequent with normal people are called illusions and hallucinations. At times, especially in the insane, we find that complex situations and less direct stimuli are apprehended by an individual wrongly, and they lead to the expression of beliefs which are contrary to the experience of others, or opposed to generally accepted beliefs. Some of these false beliefs are called *delusions*. As usually defined a delusion is considered to be false belief not directly or immediately dependent upon definite sensory stimulation or upon percepts, and in this respect a delusion may be differentiated from an hallucination, a paresthesia and an illusion.

It should be understood, however, that not all false beliefs are delusional in nature. Some are clearly mistakes due to insufficient knowledge. Many years ago it was commonly believed that pelicans fed their young with their own blood. It was also generally held that the sun revolved around the earth. These beliefs were apparently due to lack of knowledge, and although the first scientist who disputed the truth of either of these beliefs opposed the generally accepted belief of the time, his beliefs were later held to be reasonable and not opposed to experience.

Other false beliefs may be due to memory defects. For example, if on a Tuesday a man should say "To-day is Sunday," the statement would be an expression of a false belief, but the expression of this belief may not in itself be an indication of the presence of a delusion. If the man had only recovered from the prolonged effects of a drug such as alcohol or morphine, under which influence he had been since the preceding Saturday, or if he had just recovered consciousness after a period of unconsciousness of three days, the expression of the belief that the day is Sunday would not in itself indicate that he was deluded. He would have good reason to believe it was Sunday. The most natural and most normal belief he could have under the circumstances would be that he had been drugged or unconscious and that he had just awakened from a period of unconsciousness. The intervening period would be for him the same as if he had been asleep.

In a similar manner mistakes in dates may be made, which are not delusional. Critics tell us that December 25, Christmas Day, is not the date of the birth of the Christ, but a date established in accordance with

the relics of pagan observances. Such a belief in the date of the nativity of the Christ is quite consistent with the beliefs of one's neighbors and with one's education and experiences.

Beliefs which are widespread and which may be called social beliefs, even though they be false, are not technically considered to be delusions. There are many popular beliefs of this kind which have no foundation in fact. The childish beliefs that it is unlucky to walk under a ladder, or to permit a pin to remain on the street if you see it, or to walk upon the cracks in the sidewalk, are examples of these. Such beliefs have probably arisen in more primitive conditions of life and the beliefs have been handed down from generation to generation, although not always in the same specific way. It has been suggested that the widespread belief regarding the harm which may ensue from leaving a pin on a pathway is due to a tradition which has come from the time when shoes and other protective devices for the feet were not as commonly used as they are at the present time. It may also have been due to the fact that these implements were expensive at one time, and that it was an indication of extravagance or lack of care if such objects were not picked up. Similarly, the belief in ghosts is also widespread and is probably the remnant of the mysterious ideas which were prevalent among primitive peoples as explanations of those things which could not be understood or explained in simple terms.

The mental association in the relation of cause and effect of two occurrences because two events have at one time been encountered in a temporal series is frequently met with among the uneducated. Similar causal connectives are believed in by those who, although educated, have not sufficient knowledge of the conditions of the phenomena with which they deal. The belief that certain individuals had supernatural powers or were in league with the devil was widespread among all classes several hundred years ago, and many people were whipped or burned because they were thought to be witches and capable of exerting an evil influence on others, such as producing sickness and death. The occurrence of sudden illness following certain actions of visitors was responsible for some of these beliefs, although the causative connection was not apparent. In these cases a certain mental "set" or attitude (the general belief in the supernatural) was the determining element which resulted in the individual beliefs. At the present time such beliefs are found among the uneducated, and they are especially numerous in communities which are isolated to a great extent from the rest of the world. Thus, the screeching of an owl is believed by some to portend coming misfortune; a dog howling at night means that some one had died or is going to die; the appearance of a strange black cat in one's house is a sign of approaching illness or ill luck (although in certain communities it is considered lucky); crows foretell misfortune; etc.

The belief that in some yet unexplored region of the earth or on some of the other planets, *e. g.*, Mars, there is to be found a race of beings intellectually, morally and physically superior to the remainder of mankind is a belief of a different character from those already considered. In regard to this kind of belief we have no definite evidence that gives us the right to say that this is not true, but neither has the individual any evidence that the belief corresponds with actual fact. Such a belief may arise because of some religious considerations, as, for example, that since the known races of man are imperfect God has also created perfect men, or has caused a race of superior beings to be developed. Or such a belief may be the consequence of a vivid dream, or a too realistic acceptance of a novelist's tale. Such a belief corresponds with the character of the belief of a child in the phenomena of birth, that babies are brought by storks or are to be found in cabbage patches, or with the belief that the moon is made of green cheese, or that there is a race of giants which eat ordinary-sized men, or that there are good and bad fairies which oversee the actions of man and reward or punish accordingly.

All of the beliefs which we have considered may be false, but simply because of their falsity they are not necessarily delusions. Characteristics other than that of falsity must be present to warrant the designation of a particular belief a delusion. Let us consider the false belief regarding the day of the week. If the individual who expresses the belief that "to-day is Sunday" when in reality it be Tuesday does not listen to reason, if, for example, he is taken to various churches and is shown that these buildings are closed at the time of day that Sunday services are announced upon the bulletin boards, and if he is taken to the business districts and is shown that the shops are open and that people are coming and going and making purchases as on a week day, and if, furthermore, the newsboys with morning or evening papers sell him a copy which shows by its date line that it is issued on Tuesday, and he still persists in his belief, there is something added to the false belief. If these evidences do not sufficiently appeal to his reason so that he gives up the belief, it may be said that, in addition to being false, the belief is *unreasonable* and *opposed to the experiences* of others in his community. There is, therefore, more reason for calling the false belief a delusion.

Although mistakes (such as that of the day of the week) may result in appropriate kinds of reactions, this has been considered to be a typical characteristic of delusions. Certain false beliefs are, however, of such a character that they lead to no reaction, although most frequently delusions do bring about behavior appropriate to the belief. The association of special activities with special beliefs is not any more characteristic of delusions than of true beliefs, and the fact that a false belief is

accompanied by behavior appropriate to the belief does not warrant the conclusion that the false belief is a delusion. The firm belief of the negro in voodoo, or of the ignorant peasant in fairies, banshees and ghosts, may result in particular types of reactions. The beliefs may be associated with behavior appropriate to the beliefs and even give rise to actions which are similar to the reactions of the insane. It must be recognized, however, that these beliefs are often consistent with the individual's previous experience and with his education. If such beliefs were held by an educated man, they would be inconsistent with his previous life and his environment; and since they are opposed to the experience and beliefs of his friends and acquaintances and bring about particular reactions on his part, we would consider them to be delusions. The ignorant negro who lies on his back when he has a pain in the abdomen or in some other part of his body, and loudly calls for his spirit to return to him shows by his actions that he believes the pain is an indication that his spirit is departing from him. His belief, however, is quite consistent with those of his neighbors, the remainder of his tribe, and they are very effective causes of action.

Under certain conditions individuals may have false beliefs, and these false beliefs for them be scientifically not delusions, although similar beliefs on the part of others would be considered delusional. Thus, for example, a child may believe that the moon is made of green cheese. This may be firmly fixed. It is not, of course, dependent upon immediate sensory stimulation and can not be corrected by an appeal to reason, but this belief is perfectly consistent with the child's previous education and training, and it does not bring about any particular mode of reaction. In the same way the belief that the sun revolves round the earth may be held by many and may, on the other hand, be quite consistent with the experience and belief of the individual's fellows, and possibly may not be corrected by an appeal to reason.

Nor is it necessary always that the delusion be a false belief. It is sometimes only necessary that the reasoning by which the individual arrives at the conclusion be abnormal or false. Thus, the belief that at the North Pole or at the top of a mountain a particular kind of rock may be found may be quite true if it is tested by experience. Lacking such experience and assuming or concluding that the special kind of rock is to be found because one has heard God whispering to him gives the false belief a character quite different from the other false beliefs which have been considered. Such a belief is rightly called a delusion, even though the truth of the fact be demonstrable. The delusional element in such a case is not necessarily the falsity of the belief, but the manner in which the conclusion or belief was attained.

Delusions have many characters. Some of them are held for only a brief period of time; they give place to other beliefs which are equally

fleeting, and for this reason they are called *changeable*. On the other hand, certain of these delusions are *fixed*. They persist for long periods of time, and although they may not remain rigidly the same, their general character persists in spite of slight alterations or elaborations.

One may also consider the delusions from another standpoint. Some of them have very few mental connections, and they do not result in forms of activity which are combined with the remainder of the individual's mentality. Apparently they do not become an integral part of his personality and they do not appear to affect him in many ways. His life is carried on as though these beliefs were not present. Such delusions we call *unsystematized*. Opposed to them we have others in which there is greater or less systematization. The belief of the patient with general paralysis of the insane that he is wealthy causes him to go out and order dozens of horses, to purchase hundreds of knives or razors, to dine at the most expensive restaurants, to commit all kinds of absurd actions which are quite consistent with his beliefs, but which are inconsistent with the experience of his neighbors. Such delusions which lead to appropriate reactions, and which dominate the activities and mind of the individual are spoken of as *systematized*. They have become a part of the individual.

From another standpoint delusions have been divided into a number of classes in accordance with the ways in which the ideas have relation to the individual. We may speak, therefore, of *somatopsychic* delusions when the delusions refer to the body, of *autopsychic* delusions when they refer to the personality, and of *allopsychic* delusions when they refer to the external world. These different classes are not always distinct, and it is not always possible to classify all delusions in this manner. As examples of these delusions the following may be cited: of the somatopsychic, the individual may believe there is a snake or rabbit in the abdomen, or that the abdomen does not contain its full quota of organs, or that the individual has lost a leg or that the whole body is missing; of the autopsychic, delusions of poisoning (possibly also somatopsychic), the individual has very great strength or power, he has a hypnotic eye; of the allopsychic, those in relation to the external world, the individual may be a Messiah, he has committed the unpardonable sin. There are many varieties of these referring to the different parts of the body and to the different relations of parts, and at the same time the somatopsychic, the allopsychic and the autopsychic may be compounded into one.

Some delusions have a gradual growth, others are almost fully developed in an instant. The latter are usually found associated with hallucinations, or strictly speaking, they themselves may be hallucinations. If we consider the mode of development of one of these delusions, we shall realize this. Let us say, for example, that an individual

expresses a belief that he is a king. This delusion, when analyzed, or carefully observed during its development, is found to result from processes like the following. The individual has always been poor; he has had very great difficulty in making sufficient money to purchase for himself food of the character he craves, or to buy clothes to keep himself clean and respectable in appearance. At times, because his views of life have been different from those of his companions, he has found that he has been associated with other people of his own financial situation with whom he has not been *en rapport*. Their mental and moral coarseness has jarred upon him and caused him to believe that he is somehow and in certain particulars quite different from those with whom he normally associates. Then he finds it difficult to obtain a position. Owing to his inefficiency he loses one position after another, and because of his belief that he is different from his co-workers, there comes the next step in the delusion formation, the belief that people are down upon him, or are persecuting him. The final step is easy. The reasons for the persecution are sought; he considers various possibilities; he thinks about his past life, of the various positions from which he has been separated owing to no fault of his own (as he thinks); he sees no definite connection between the losses of his positions and his own incompetency, or between his lack of harmony with his fellow workmen and his own mental condition; he begins to believe that there must be some united effort to bring about these adverse conditions. Sometimes he believes this external influence is exerted by the Masons; sometimes it is one or other of the churches; and at other times he believes his difficulty has been due to the fact that his social position, if known, would be higher than that of those who persecute him. Eventually he comes to believe that he is a legitimate son of a certain ruler, and that all of his troubles have been due to the fact that in childhood, or perhaps in babyhood, another infant or child was substituted for him and that various difficulties have been made to prevent his assuming his proper place and to keep him down. From these beliefs it is an easy step to the belief that he is to be the lawful king when his supposed father dies. In general, such is the mode of development of the so-called systematized delusion which arises gradually, and which is thought out.

On the other hand, delusions may arise suddenly as if by inspiration. These latter, as has been previously suggested, usually come because of particular kinds of hallucinations which convey messages indicating the individual's supposed greatness or his unworthiness. Here the auditory hallucinations usually play the most important part. The voice of God may be heard telling him that he is the Messiah, or he hears voices constantly saying that he must be kept out of the way in order that another may have the place which lawfully belongs to him,

or he hears a voice calling him evil names, and in the presence of such hallucinations, a delusion may suddenly arise. Other delusions of apparently sudden origin probably arise from other causes, some of them being the end result of a number of experiences, hallucinatory it may be, no one of which by itself has been sufficiently powerful to beget a delusion.

The somatopsychic delusions, Southard has well shown, may arise because of, or be concomitant with, stimuli resulting in particular kinds of sensation in particular parts of the body. Thus, he describes the case of a woman who expressed the belief that she had been shot in the breast with a "seven-shooter." The patient could not show any signs of a wound, nor were there any external signs visible. There were noted pleuritic friction sounds and the autopsy revealed a fibrous pleurisy at the point at which she believed she had been shot. Whether or not the form of the delusion, namely, the belief in being shot, was due to other experiences, can not be determined. In this case the conclusion that there is a relation of the particular pathological condition of the pleura and the definite ideational localization of the point of the shot with the somatopsychic delusion is not only suggested, but almost forced upon us. The ideational selection of the particular weapon (a seven-shooter) may be indicative of other causes which acted in conjunction with the abnormal sensations.

Other cases which Southard has reported have equally suggestive histories indicating that the abnormal sensations from different parts of the body may give rise to delusions of a somatopsychic character. Thus, he has recorded the case of a man who complained of torpidity of the bowels. This patient almost constantly kneaded his right chest and abdomen because of this supposed condition. At the autopsy a number of pathological states were found in the region to which he referred his delusion, and one of these, namely, the right lung was adherent to the pleura, is sufficient to mention. Another patient complained that his stomach was always full and that he could not eat, and this belief was found to be associated with the pathological finding of intestinal obstruction from cancer. In this case probably the passage of food stuffs from the stomach into and through the intestines was retarded, and it is not difficult to conclude that the belief that the stomach was full had, partially at least, its origin in, or was built upon the foundation of, the abnormal sensations which accompanied the morbid modes of gastric and intestinal activity. The accumulation of cerumen in the ear of another patient was accompanied by the belief that bugs or buzzing flies were present.

Two other cases in which no peripheral lesions were found to correspond with the delusions are cases in which cerebral lesions were found to accompany the beliefs, (1) that the insides were gone and,

(2) that there was gravel in the head. The examination of the brain of the first of these cases revealed lesions in the optic thalamus. When we recall the fact that the thalamus is a subsidiary, although very important, sensory ganglion which receives the nervous impulses corresponding with the sensations of touch, pressure, temperature and pain, before these impulses are passed onwards to the cerebral cortex, and that in the non-insane lesions of this ganglionic mass result in anaesthesias, it is not difficult to understand that this particular cerebral lesion may have a very definite relation to the belief that the insides are gone. A similar correlation has also been recorded by Southard in the case in which the belief that "the insides were gone" was associated with a lesion in the cerebral postcentral gyri (sensory center).

It will be noted that these cases in which somatopsychic delusions are associated with variations in the sensations from the bodily periphery resemble those conditions which are grouped under the general heading of illusions. In certain cases those beliefs which are apparently delusions might very readily be considered to be paresthesias (illusions), but there is one particular in which they sometimes differ, viz., the delusions can not be correlated with definite changes in parts of the body until after death. This is especially true for those cases in which the delusion or false belief has been associated with a lesion of part of the cerebrum. If we should carefully and consistently omit from the class of delusions all those conditions in which there are concomitant physical abnormalities which might result in sensory abnormalities, we should probably classify the above cases of Southard with illusions or hallucinations. Since, however, many of the physical pathological conditions can not be determined until after death, we should need to withhold any particular designation until after that event, and an accurate designation could not then be made unless an autopsy were performed. It would therefore not be possible to distinguish between delusions and illusions and hallucinations. Obviously the matter must be settled in a more practical manner and it appears best to designate the more definite interpretative elaborations as delusions regardless of their source. Thus, internal ear diseases may result in sensations which give rise to the reports that "there is a buzzing in my ears," or "people are talking about me," or "there are bees in my head." Since it is not possible to determine in every case the definite relation of an idea to a particular stimulation the interpretative additions of the last two forms of reaction give warrant for the designation of delusion. The indefiniteness of the "buzzing in my ears" is similar to the well-known paresthesias of tingling and formication, and may be classed with these, even though the morbid process leading to the abnormal sensations be unknown. The interpretative elaboration may in these cases be the only criterion differentiating the delusion from an hallucination or an illusion.

On the other hand, there are numerous delusions which are undoubtedly due to what Freud and his school call a "wish fulfilment." Burrow had described such a case. An unmarried woman for a number of years had complained of weakness, indigestion, distension of the abdomen, pain in the back and groin, which conditions, as far as could be determined, were not associated with any abnormal physical state. A psychoanalysis of this patient showed that she had had very great desires to be married; her dreams were of marriage and of bearing children; and her mental life had been colored by or made up largely of these wishes. The physical conditions of which she complained were taken by Burrow to be the outward signs of the conditions which she hoped she might have, namely, those of pregnancy as a result of marriage. Jones has also well described a case of a similar nature. This woman exhibited erythrophobia, *i. e.*, fear of red, and at the same time she believed that she was responsible for or had actually caused the death of her mother. A careful mental examination showed that for many years she had been compelled to remain at home to take care of her mother, who was an invalid, that because of this she had been unable to have pleasures similar to those which she found girls of her age were having, and from time to time these conditions led to rebellious ideas. The health of her mother improved to such an extent that she was enabled to go to college or school and thus again take up her life in association with other girls. At school there was a debate in which she took part and in which, as one of the contestants on one side, she wore a red shield on her arm. Subsequent to this event she dreamed of seeing her mother lying dead, in a room on the wall of which there was a red shield. On account of worry over her dream, she went home, taking the red shield with her. She was pleased to find her mother very well and, laughingly explaining her fears, she pinned the red shield on the wall of her mother's room. A day or two later upon awakening in the morning, she went to see her mother and found her dead in bed. Thence, it is explained, originated her belief that the act of pinning the red badge upon her mother's wall had something to do with the death of her mother, and thence also arose the fear of red. It was also learned that because of the lack of pleasure in life she had at times considered how much better off she would be if her mother were dead, and perhaps had also unconsciously wished for such a solution of her difficulties. When, however, there was accomplished the actual result which she had wished, her action in placing the red shield upon her mother's wall became prominent in her mind and she believed she had been warned about this in her dream.

Numerous other cases of a similar character might be cited. Most if not all, delusions are interpreted by the Freudian school in this manner. Brill, for example, interprets certain delusions of grandeur

as being due to an overestimation of the self (of a sexual character), and the Freudian conception of paranoia, with its fixed and systematized delusions, is that it is a defense reaction of this nature. The symptoms are due to unconscious elements which act in a fashion somewhat similar to, although more powerful than, conscious ideas. These types or cases may be considered to be somewhat different from those of Southard in that they are of an ideational rather than of a sensory type.

On the other hand, we sometimes find delusions which can not be considered strictly ideational or strictly sensory in character, and it is very likely that many of the so-called ideational cases have certain sensory elements, and on the other hand that certain of the sensory cases have ideational elements in them. Such a case, with details learned at a time when the delusion was at its height, is the following; the patient was a woman who had been in love with a young man whom her mother considered to be entirely unsuitable, and because of this kept the man away from the house and, by her insistence, practically compelled the daughter to marry another man who was wealthy and socially more eligible. The man whom she married she did not love and, in fact, very much disliked. She bore several children to him, but believed that their relations were not morally right. Because of her ideas and her dislike for her husband she had lacked normal enjoyment in her married life and had frequently longed for death. Eventually she exhibited signs of insanity and was committed to a hospital. She continually said she was dead, that the physician might cut off her finger or her arm or her head without finding a drop of blood. She was not particularly untidy; she could do accustomed things very well; she dressed herself; she walked and talked and in her actions gave a lie to the beliefs which she expressed, but it was impossible to shake her belief either by reference to her acts or in any other manner. She was completely anesthetic and analgesic. This case shows physical signs, namely, anesthesia and analgesia, which may be correlated or believed to be correlated with the delusion, and on the other hand there are elements in the history similar to those which were found in the cases of Burrow and Jones. It was not determinable whether the anesthesia preceded the belief in her nonexistence or the reverse.

A fourth class of delusions is not infrequently encountered. In cases of arteriosclerotic or senile dementias or in a Korsakow's syndrome patients frequently recount their journeys of the night before; they tell how they had been fishing the previous day; they had been brought to this hotel (the hospital) an hour or two ago, or have had visits from friends, when none of these things had occurred. Here the delusion appears to be based upon memory lapses or defects. The patient does not remember the occurrences of yesterday, even those of the same

morning, and the memory gaps are filled out by the patient, often with those occurrences which the patient would like to have had occurred. In this way such delusions may be considered to be allied to the ideational type, those of wish fulfilment which were described above.

An amnesia may lead to a delusion or false belief regarding the locality of a given place. An excellent example of this has been described by Alzheimer. A Russian who had emigrated, and located in Frankfurt, was taken to a hospital, where he insisted that he was in Russia. He could not recall any of the incidents of his removal from Russia and the period of time between his emigration from Russia until his admission to the hospital was lost from memory. The most natural conclusion for the patient under these circumstances was that he continued to be in Russia. Such a disorientation may be considered to be a delusion due to the lack of recognition of dissimilarities.

Kraepelin cites a somewhat similar case, due, however, to a different kind of memory defect, which was described by Ganser. This patient was a boy who had been admitted to the Munich psychiatric hospital who insisted that he was in Vienna. He also believed that he had been asked to join a company for the development of the Sahara Desert, that he had been in London to consult with others regarding this, and had just returned to Vienna in a balloon. The whole story was bizarre and apparently without reason, until it was subsequently learned that the patient had borrowed practically the whole system of ideas from a novel which he had read some time previously. He had forgotten the fact that he had read the book, but he remembered the incidents, and since the incidents could not be given their proper setting he assumed that they had happened to him. In this case the defect of memory was a defect in the sense that previous occurrences were not properly located as to personality. The special incidents were suitably remembered, but the reference of them was erroneous.

Closely associated in character with the delusions which have just been described are others which the French call *"deja vu"* and *"deja entendu."* These are conditions in which the individual experiencing them believes that he has had similar experiences in the past. In a perfectly new situation, in a place which he has never before visited, a person believes that he has been a visitor there at some previous time. Or words which are read in the newspaper or words that are heard are believed to be exactly the same as others which he has experienced in the past, not only with respect to the individual words or their combination, but also with respect to their context and their meaning as applied to him. These feelings of having already experienced such situations are frequently due to memory defects. But in these cases the memory defects are of quite a different character from those in the cases which have previously been described. In the condition of *"deja vu"*

it is probable that what takes place is that one or several elements in the present situation are like those which had been experienced in the past, but that the dissimilarities in the situations are not observed. The individual has a memory defect in that he parallels or identifies a complex present experience with a similar complex past experience, although in the present experience the number of elements which are the same as those in the past may not be very great. In other words, the present experience is deemed to be the same as that of the past because of the fact that the past is not accurately remembered and properly localized in time.

Throughout all of these delusions one may discover that, in general, there are two ways in which they arise. As far as can be determined, Southard points out, the patients take data which are erroneous, such as the lack of sensation (anesthesia) and interpret the lack of normal sensation in a normal manner, viz., lack of sensation means that the part is missing. By a normal individual a different interpretation may be made, but the delusional interpretation is, it should be understood, equally logical. We may conclude, therefore, that delusions are sometimes due to the fact that abnormal sensory conditions are appropriately and logically interpreted. On the other hand, these delusions may also arise because of abnormal or faulty methods of interpreting the data which are correctly received by the patient. Thus, the woman who experienced a pain due to pleurisy did not say "I have a pain in my chest," but "I have been shot in the chest." In every case it is not always possible to determine whether the delusions are due to elements of abnormal data or elements of abnormal reasoning. It is possible that in every case both of these elements are to be found. As a rule, in those who are not mentally unbalanced anesthesias and pains do not lead to delusional interpretations. When the sciatic nerve has been cut in an otherwise normal individual the lack of sensations which are normally received from the foot and leg does not lead to the interpretation that the foot or leg has been cut off or is missing. Experiences through other channels of sense are added and are combined to interpret the phenomena in a normal manner. The leg exists, but it is not felt. The lack of feeling does, however, imply non-existence and this conclusion is most direct. Correction of this interpretation because of sensations obtained from other sources (*e. g.*, the eye) are indirect. It is perfectly logical for the man suddenly stricken blind to believe that it has suddenly become dark. It is only by an extension of experience and by the utilization of other means of arriving at a conclusion that the logical interpretation gives way to what may be termed a "normal" interpretation. The formation of delusions as the result of abnormal modes of interpretation is probably most frequent.

DUCTLESS GLANDS, INTERNAL SECRETIONS AND HORMONIC EQUILIBRIUM. II

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In the first half of the nineteenth century the accepted view of the phenomena of secretion was that enunciated by Johannes Müller, viz., that the process consists of two phases—secretion proper, or the casting out of substances upon a surface inside the body, as in the case of the gastric juice; and "excretion" or the voiding of such secreted substances into the external world, as in the case of bile or urea. This distinction was somewhat artificial, since bile, urea and other excreted substances are also secretions in the first instance. In 1801[16] the French physiologist Legallois, as Gley has noted, surmised, from the identity in composition of all varieties of arterial blood and the diversity of venous blood in different parts of the body, that this diversity is acquired, in each case, from the loss of some substance to the organ from which the vein proceeds. Thus Bordeu's idea: A (arterial blood) $= S$ (secretion) $+ V$ (venous blood), and Legallois's idea: V (venous blood) $= A$ (arterial blood) $- S$ (secretion) are identical. When A and S are chemically known, A being constant, V will be known; or, when A and V are known, S will be known. V is always a variable. This remarkable intuition of Legallois, like the hypothesis of Borden, remained on a theoretical basis and was not put to experimental proof. In 1849, A. A. Berthold,[17] a Göttingen professor, is said to have transplanted the testes of a fowl to another part of its body, with complete retention of its sexual characters, a phenomenon which he inferred to be due to "the productive relation of the testes, *i. e.*, to its effect upon the blood and thence through the corresponding effect of such blood upon the entire organism." This *aperçu*, again, does not differ materially from that made by Bordeu in the eighteenth century. In the meantime the ductless glands were coming to be known among the German physiologists as "blood-vessel glands" (*Blutgefässdrüsen*) or "blood glands" (*Blutdrüsen*) and were regarded by the histologists Henle and Kölliker as preparers of different chemical substances which are utilized by the organism through the blood. Beyond this general theory, which is identical with Bordeu's, no special function could be assigned to the different ductless glands. Even Henle asserted that these glands have no influence whatever upon animal life, that they can be extirpated or undergo pathological degeneration without affecting either the sensory or motor functions of the body. The path-breaking importance of Addison's great monograph on the effect of disease of the suprarenal capsules may be thrown into relief by citing Hyrtl's witticism about the suprarenal—that the un-

[16] Legallois, "Œuvres," Paris, 1824, II., 209–210. Cited by Gley.

[17] Berthold, *Müller's Arch.*, Berlin, 1849, 42.

known nature of its functions insures it from bothersome investigation at the hands of medical men (*"Die unbekannte Funktion der Nebenniere sichert dieses Organ von lästigen Nachfragen in der Heilwissenschaft"*).

If we regard the lungs or the individual cells of the body tissues provisionally as ductless glands, then it will be perceived that the truth of the equation formulated by Legallois had already been demonstrated quantitatively when Lavoisier proved that inspired air is converted into carbon dioxide and water, and when Lagrange, through his pupil Hassenfratz, proved that the oxygen in inspired air, being dissolved in the blood, takes up carbon and hydrogen from the body tissues as the blood courses through them (1791). We now know that the respiratory center in the medulla is stimulated by the CO_2 in the venous blood, which Lavoisier and Lagrange had shown to be, in effect, a true metabolite, or waste-product of tissue-oxidation. Their work was in fact the starting point of the chemical study of metabolism, which received its next great advancement in Claude Bernard's study of glycogen; for although the latter may not be, in the strict sense, a true internal secretion, discharged from a gland into the blood, yet its investigation led Bernard to the classical statement of the doctrine of internal secretions as such:

> In animals, the glycogenic secretion is an internal secretion because it is discharged directly into the blood. I have considered the liver, as found in the higher vertebrates, as an organ with a double secretory function. It seems to reunite, in effect, two distinct secretory elements and it represents two secretions, one external, the biliary secretion, the other internal, the glycogenic secretion, which is discharged into the blood.[18]

In the year 1843, Claude Bernard, in his graduating thesis, made the discovery that cane sugar is acted upon by the gastric juice, being converted by it into dextrose. This experimental fact led to a train of reasoning which was to revolutionize the physiology of nutrition and metabolism and at the same time to introduce the new concept of internal secretions and to be the starting point of the experimental production of disease by the artificial use of chemical and physical agencies. All carbohydrates, Bernard reasoned, must get into the blood in the form of dextrose. "What becomes of this dextrose?" he next inquired. Somewhere between the alimentary canal (*via* the portal vein) and the liver, between the liver (*via* the right heart) and the lungs, between the lungs (*via* the left heart) and the various body tissues, this dextrose is either destroyed and disappears or is transformed into some other substance. If the locus of this transformation could be discovered and its activities inhibited, an artificial diabetes might be produced by the induction of excess of sugar in the blood. On feeding a dog on rich sugar diet and killing it at the height of digestion, he found the hepatic veins loaded with dextrose, and although this looked at first as if the

[18] Bernard, "Leçons de physiologie expérimentale," Paris, 1855, I., 96.

liver was not the site of transformation, Bernard changed his mind when he found that the blood from the hepatic vein of another dog fed upon meat only (a sheep's head) was also loaded with grape sugar. Thus it appeared that the liver is a sugar-manufacturing plant, and that its sugar-producing or glycogenic function is in the nature of an internal secretion, a view which he confirmed by many varied experiments, publishing his results in 1849–50. About the same time he discovered that a puncture in the region of the fourth ventricle of the brain in the dog will produce a temporary diabetes (1849), which the later researches of Harvey Cushing and his associates indicate to be a polyuria deriving from the pituitary body. As a simple decoction of the liver substance was always found to contain dextrose, the next step was to ascertain how the liver produced this substance at the expense of the materials sent from the alimentary canal. After perfusing a freshly excised liver until the wash-water from the hepatic vein contained no sugar, Bernard found that if the liver were left in a warm place for a few hours a subsequent perfusion would once more come out loaded with sugar, and, although this property of the hepatic tissue could be destroyed by boiling, the sugar-producing power could be restored by adding to a decoction of the boiled liver a small quantity of fresh liver infusion. From this he inferred that the glycogenic function is, in effect, a fermentative process and that its agency is a kind of starch. In 1855 he succeeded in obtaining this glycogenic substance in the form of a dry powder, which could be converted into dextrose by fermentation, although it did not itself respond to the sugar tests. In 1857, by his potash-alcohol process, Bernard obtained it in the pure state as "glycogen." It was the fact that glycogen could be seen, touched, tasted and experimented upon as such that established the theory of internal secretions as a working principle in physiology. The epoch-making character of Bernard's discovery is best indicated in the language of Sir Michael Foster, who has given the most fascinating appreciation of his work in medical literature:

> The view that the animal body, in contrast to the plant, could not construct, could only destroy, was, as we have seen, already being shaken. But evidence, however strong, offered in the form of statistical calculations, of numerical comparisons between income and output, failed to produce anything like the conviction which was brought home to every one by the demonstration that a substance was actually formed within the animal body and by the exhibition of the substance so formed.
>
> No less revolutionary was the demonstration that the liver had other things to do in the animal economy besides secreting bile. This, at one blow, destroyed the then dominant conception that the animal body was to be regarded as a bundle of organs, each with its appropriate function, a conception which did much to narrow inquiry, since when a suitable function had once been assigned to an organ there seemed no need for further investigation. Physiology, expounded as it often was at that time, in the light of such a conception, was apt to leave in the mind of the hearer the view that what remained to be done consisted chiefly in determining the use of organs such as the spleen, to which as yet no definite

function had been allotted. The discovery of the glycogenic function of the liver struck a heavy blow at the whole theory of functions.

No less pregnant of future discoveries was the idea suggested by this newly found out action of the hepatic tissue, the idea happily formulated by Bernard as "internal secretion." No part of physiology is at the present day being more fruitfully studied than that which deals with the changes which the blood undergoes as it sweeps through the several tissues, changes by the careful adaptation of which what we call the health of the body is secured, changes the failure or discordance of which entails disease. The study of these internal secretions constitutes a path of inquiry which has already been trod with conspicuous success and which promises to lead to untold discoveries of the greatest moment; the gate to this path was opened by Bernard's work.[19]

In 1856, one year before Claude Bernard obtained glycogen in the pure state, the doctrine of internal secretions was put upon a firmer basis through the important experiments of Brown-Séquard and Moritz Schiff. Only a year after the publication of Addison's great monograph on suprarenal disease, Brown-Séquard succeeded in producing an exaggerated form of Addison's disease in different animals by removal of the suprarenal capsules, the symptoms being the same and the result of the experiment being rapidly and invariably fatal.[20] If only one capsule were removed, there was no appreciable change in the normal animal, but death would rapidly supervene upon removal, even after a long interval of time, of the other capsule. Furthermore, Brown-Séquard found that a transfusion of normal blood into the veins of an animal deprived of its suprarenal capsules will prevent its death for a considerable time, indicating that the normal suprarenal capsules secrete a material which is necessary for the maintenance of life. In the same year (1856), Moritz Schiff,[21] of Frankfort on the Main, found that excision of the thyroid gland in dogs is invariably fatal. His results were forgotten for over twenty-five years, when, following the description of myxœdema by Gull (1873) and Ord (1878) and the first excision of the thyroid gland for goitre by the Swiss surgeon, Theodor Kocher (1878), J. L. Reverdin of Geneva showed that an "operative myxœdema" is produced in man by complete excision of the thyroid (1882). This was confirmed by Kocher, who found that total thyroidectomy is followed by a "cachexia strumipriva" or "cachexia thyreopriva." Hereupon Schiff returned to the charge and, in 1884, published the results of 60 thyroidectomies in dogs, all fatal, with such significant symptoms as tremor, spasms and convulsions. What is more to the purpose, Schiff demonstrated that these symptoms could be prevented by a previous graft of a portion of the thyroid gland beneath the skin or into the peritoneal cavity of the animal, or by the injection of thyroid juice into a vein or under the skin, or by the ingestion of thyroid juice or raw thyroid by the mouth. This led in time to the remarkably successful treatment of myxœdema by means of thyroid

[19] Sir Michael Foster, "Claude Bernard," London, 1899, 89–90.

[20] Brown-Séquard. *Compt.-rend. Acad. d. Sc.*, Paris, 1856. XLIII., 422; 542.

[21] Schiff, "Imparziale," Florence, 1863, 234–237.

extract by Murray and Howitz in 1892. In 1884, Sir Victor Horsley produced an experimental myxœdema by removal of the thyroid in monkeys, which were found to survive much longer than dogs. It was also found by Allara (1885), Ewald (1890) and others, that experimental thyroidectomy is negative in birds, rodents and herbivorous animals, and that, both in animals and man, operative myxœdema is produced less frequently as age advances. In 1888,[22] Sir Felix Semon, in an important collective investigation, showed that cretinism, myxœdema and operative myxœdema (cachexia thyreopriva) are one and the same. In 1889, Brown-Séquard, then aged seventy-two, found himself vastly rejuvenated as to general health, muscular power and mental activity, by the subcutaneous injection of testicular extracts, the active principle of which Poehl, the Russian physiologist, holds to be the substance spermin ($C_5H_{14}N_2$). These experiments of Brown-Séquard easily lent themselves to ridicule, but he followed them up, even to the extent of giving pituitary extract for disease of that organ (1893), and it was his work upon these extracts which led him to formulate the following statement of the old Bordeu theory of internal secretions:

> All the tissues, in our view, are modifiers of the blood by means of an internal secretion taken from them by the venous blood. From this we are forced to the conclusion that, if subcutaneous injections of the liquids drawn from these tissues are ineffectual, then we should inject some of the venous blood supplying these parts. . . . We admit that each tissue and, more generally, each cell of the organism secretes on its own account certain products or special ferments which, through this medium, influence all other cells of the body, a definite solidarity being thus established among all the cells through a mechanism other than the nervous system. . . . All the tissues (glands or other organs) have thus a special internal secretion and so give to the blood something more than the waste products of metabolism. The internal secretions, whether by direct favorable influence, or whether through the hindrances of deleterious processes, seem to be of great utility in maintaining the organism in its normal state.[23]

As theory goes, nothing new has been added to the doctrine of internal secretions since Brown-Séquard stated it in this form in 1891. In his essay on "Variation" (1868) Darwin seems to have had a glimmering of the idea when he stated that gemmules are transported from all parts of the body to the ovum to insure their reproduction (pangenesis), and the Bayliss-Starling doctrine of the "hormones" or chemical messengers, as we shall see, is not essentially different from that of Bordeu and Brown-Séquard.

From the time of Brown-Séquard on, experimental investigation of the subject moved so rapidly and in so many different directions that the general trend of the theory became obscured or lost in the details of controversy. And further obfuscation was brought about by the constant succession of dissolving views of the subject of carbohydrate

[22] *Tr. Clin. Soc.*, London, 1888, Suppl. to Vol. XXI.

[23] Brown-Séquard, *Arch. de physiol, norm. et path.*, Paris, 1891, 5 s., III., 506. Cited by Gley.

metabolism. In 1886, von Mering produced an experimental diabetes by the ingestion of phlorhizin. In 1889, von Mering and Minkowski obtained diabetes by an experimental excision of the pancreas.[24] The histological, pathological and clinical studies of E. I. Opie (1901), L. W. Ssobolew (1902) and W. G. MacCallum (1909), indicated that the source of this pancreatic glycosuria is to be found in a specialized group of cells, called the islands of Langerhans. Thus it would appear that the pancreas possesses an internal secretion as well as a digestive function. The discovery of iodothyrin in the body by Eugen Baumann, in 1896, suggested the relation of the thyroid gland to iodine metabolism and an adjoining pair of ductless glands, the parathyroids, discovered by the Swedish anatomist, Ivar Sandström, in 1880, would appear, from experiment, to have an influence on calcium metabolism. In 1891, Eugen Gley showed that where excision of the thyroid is negative in certain animals, these animals will speedily die if the four parathyroids are also removed. In 1892, the Viennese surgeon Anton von Eiselsberg made a successful transplantation of the parathyroid glands from the neck to the abdominal wall in a cat and showed that tetany may be produced upon its removal from this site. Subsequent experiments by H. Leischner (1907) and by W. S. Halsted, at the Johns Hopkins (1909), showed that the production of tetany is really due to removal of the closely adjacent parathyroids. These observers found as in Schiff's experiments, that the tetanoid spasms will be abolished upon injection of an extract of the gland or after parathyroid feeding or upon regrafting the gland itself. In 1908 W. G. MacCallum and C. Voegtlin showed, at the Johns Hopkins Hospital, that tetany may be abolished by treatment of the patient with calcium salts. Another ductless gland, the pituitary body, has been shown to have a marked relation to carbohydrate metabolism and, like the suprarenal and parathyroids, to be essential to the maintenance of life. The pituitary body, which the anatomist Soemmering called the hypophysis cerebri in 1778, was, as we have seen, regarded as an organ discharging a mucous secretion into the nostrils until this theory was disproved in the seventeenth century. This structure consists of an anterior glandular lobe (pars anterior) and a smaller posterior lobe (pars nervosa), the whole being connected with the floor of the fourth ventricle of the brain by means of a stalk or infundibulum. In 1838 the embryologist Rathke showed that the anterior lobe is developed by the protrusion of an ectodermal pouch (Rathke's pouch) from the roof of the pharynx and is made up of epithelium derived from the buccal cavity. It lies in the embryonic rest of Rathke's pouch "as a ball is held in a catcher's mitten" (Cushing). The posterior lobe is made up of nervous tissue and is derived from a corresponding prolongation from the anterior

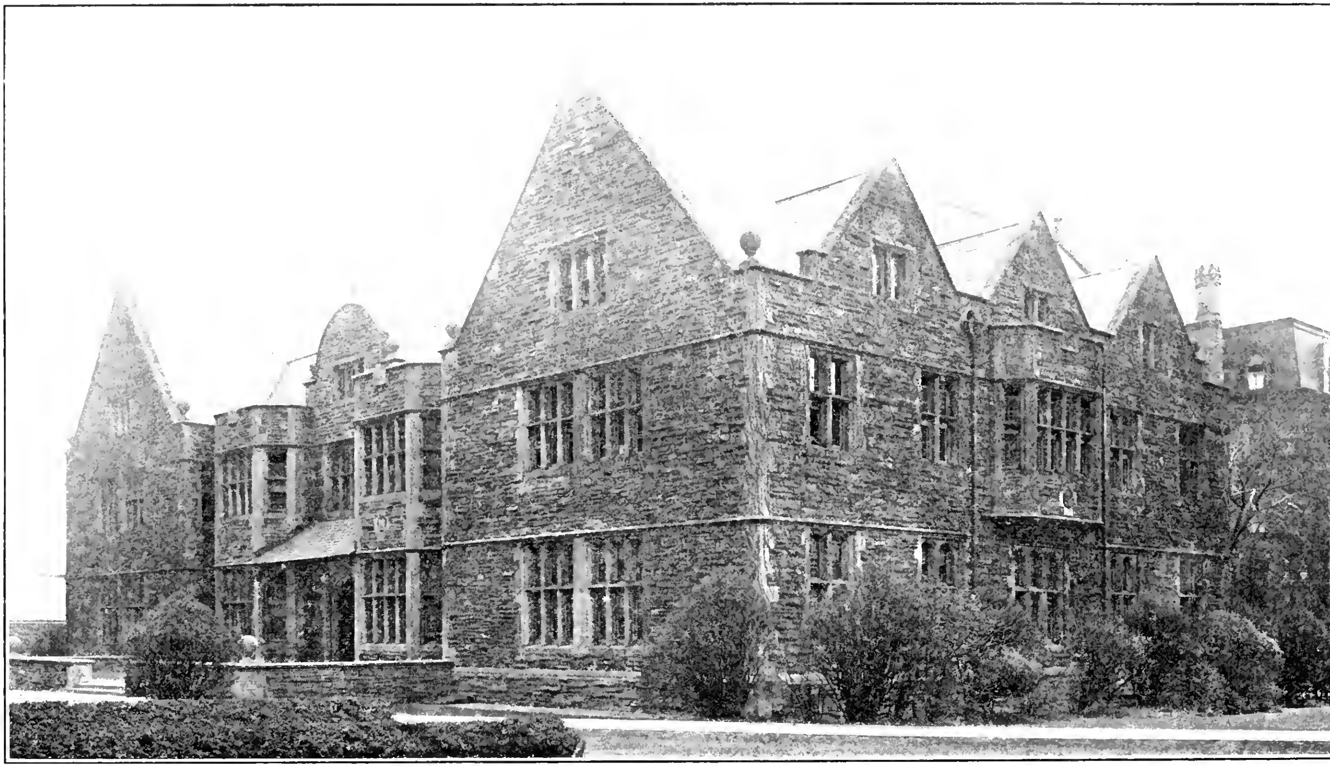
[24] Von Mering and Minkowski, *Arch. f. exper. Path. u. Pharmakol.*, Leipzig, 1889, XXVI., 371.

cerebral vesicle. Until recently the pituitary body has been inaccessible to surgeons and to physiological experimenters by reason of its encasement in the sella turcica of the sphenoid bone. Experimental removal of the pituitary (hypophysectomy) was essayed by Horsley (1886), Marinesco (1892), Vassale and Sacchi (1892–4), Gatta (1896), Biedl (1897), von Cyon (1898–1900) and others, with negative or contradictory findings, resulting no doubt from the difficulties encountered in approaching the gland through the skull and of insuring its entire removal under these conditions. In 1908, an important advance was made by Nicholas Paulesco of Bucharest, who devised an operation by the temporal route and showed that the pituitary body is essential to life, its removal being fatal to the animal. At the same time, he found that removal of the anterior lobe is equivalent to entire removal and that excision of the posterior lobe is negative. Paulesco's experiments were put to the test by Harvey Cushing, now professor of surgery at Harvard, and his associates at the Johns Hopkins Hospital, their experiments being performed mainly upon dogs. They found that total removal or removal of the anterior lobe alone are alike fatal, the animal dying in three days with a peculiar train of symptoms consisting of lowered temperature and blood pressure, sluggishness, unsteady gait, rapid emaciation, slowing of pulse and respiration, diarrhœa, diminished urine in adults; polyuria and glycosuria in puppies. Partial removal of the anterior lobe in normal dogs was found to produce a pronounced state of obesity, with a remarkable shrinkage of the external (male) genitalia. In other words, Cushing produced, by experiment, a genuine pathological reversion to the condition known as sexual infantilism or "dystrophia adiposo-genitalis" (Fröhlich's syndrome). In the case of the posterior lobe, which, as shown by Cushing and Goetsch, discharges its secretion into the cerebro-spinal fluid, partial removal or the production of insufficiency of the secretion by putting a clip upon the stalk of the gland, produces, at first, a temporary lowering of the animal's assimilation-limit for sugars, followed by a marked and permanent increase in its tolerance for carbohydrates, which is again promptly lowered by injection of an extract of the posterior lobe. In 1895 Oliver and Schäfer found that the mammalian pituitary possesses an active principle which, upon injection, elevates the blood pressure and increases the force of the heart beat. In 1898 Professor William H. Howell, of the Johns Hopkins University, showed that this property is possessed by the extract of the posterior lobe alone. In his Harvey Lecture of December 10, 1910, Cushing introduced the pathological idea of "dyspituitarism" or perverted function of the gland, as a generic concept, covering excess or insufficiency of its function, and for the following reasons. In accordance with the clinical and pathological findings of Parry, Graves and Basedow, exophthalmic goiter was regarded as a state of "hyerthyroidism," or excessive secretion of the gland, while the myxœdema of Curl-

ing, Gull and Ord was termed "hypothyroidism" (diminished secretion or insufficiency). But it was found that, in many cases the two conditions may be blended, as Paracelsus had originally surmised in the Salzburg region, producing an overlapping of the cardinal symptoms of either. For this condition, the term "dysthyroidism" was proposed by Marie for both. In like manner, states of over activity in the pituitary (hyperpituitarism) or of under activity (hypopituitarism) may be superimposed, one upon the other, making the term "dyspituitarism" most appropriate in the majority of cases. As a goitrous mother may have a cretinous infant, so, as originally observed by Crookshank and confirmed by Cushing, a big, bony acromegalic woman may have a son afflicted with pituitary infantilism or obesity. Cushing has also shown that there is evidence of pituitary activity in pregnancy and hibernation (1912) and his experiments upon its relationship to the sympathetic nervous system (1913) have led him to the conclusion that a lesion of the posterior lobe is the principal cause of the increase of normal urine (polyuria) otherwise known as diabetes insipidus. Finally, he had devised a standard surgical procedure for approaching the almost inaccessible pituitary gland, which was first operated upon in man with success by H. Schloffer in 1907. Cushing's work is thus a brilliant contribution to physiological or Hunterian surgery which had almost fallen into abeyance until the twentieth century and which has been the principal means of elucidating the obscure physiology of the ductless glands.

In this connection, it is interesting to note that the first experiment in physiological surgery upon human beings was performed by the gynecologist Robert Battey, of Georgia, who on August 27, 1872, excised the normal ovaries for the relief of a neurotic condition. The physiological basis of this operation, a supposed internal secretion from a specialized set of ovarian cells, has been indicated in many ways. Ovariotomy has been found to have a beneficial effect upon osteomalacia in women. Glass (1899), Morris (1901), Marshall and Jolly (1905) have shown that grafting or transplantation of the ovaries in previously ovariotomized women will reestablish menstruation, sexual desire and general well-being. The experiments of Starling and Lane-Claypole (1906) demonstrated that the inhibitory effect upon pregnancy and lactation of a Battey's operation in rabbits will not be produced by section of the mammary nerves or of the spinal cord. Similarly, the experiments of Brown-Séquard and Poehl on spermin and the fact that ligation of the vas deferens in young animals will abolish the power of reproduction, while permitting full development of the sexual characters and the sexual appetite, go to show that the sexual gonads in the male have an internal secretion, which is supposed to arise from the interstitial cells of Leydig, in the seminal tubules.

(To be concluded)



HOUSTON HALL, the Students' Clubhouse at the University of Pennsylvania, the Headquarters of the American Association for the Advancement of Science.

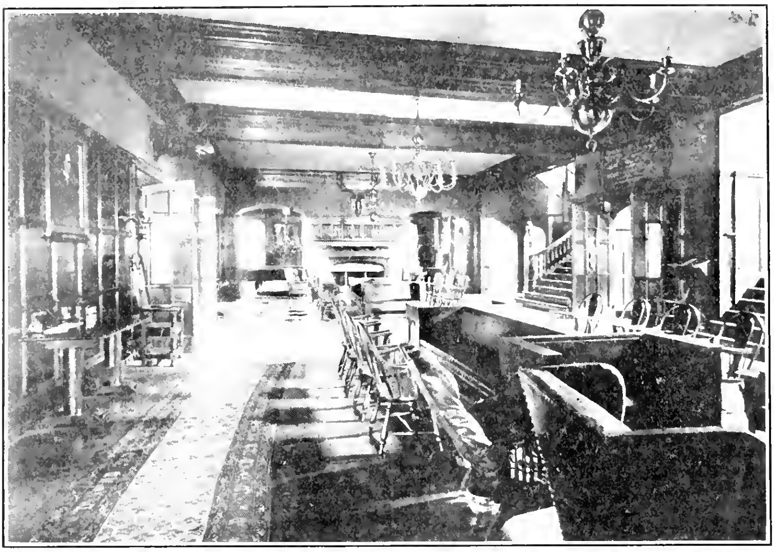
THE PROGRESS OF SCIENCE

THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE American Association for the Advancement of Science and the national scientific societies affiliated with it meet at the University of Pennsylvania, Philadelphia, during the week beginning on December 27. In view of the scientific attractions of Philadelphia and its central situation for those living on the Atlantic seaboard, with convenient access for those living further west, the meeting is sure to be of outstanding importance. This has been the case with the previous Philadelphia meetings. The association was organized there in 1848. After an interval of 36 years the second Philadelphia meeting had a registration of 1,261, the largest up to that time and until very recently. Like the first meeting it marked an epoch in scientific organization in America. Until 1882 there had been only two sections of the association, one for the exact sciences and one for the natural sciences. But the advance and specialization of science led to the division of the association into sections and the establishment of national societies for the different sciences. The American Society of Naturalists was established in 1883 and as special societies were organized in the natural sciences they met with it in the Christmas holidays. National societies in the physical sciences were also formed and held separate meetings. The parent association was thus somewhat weakened, and the summer meetings attracted an attendance of only about 300.

The situation was met by the establishment of convocation week and the affiliation of the national societies for special sciences with the association. The association has aimed to serve as a center of coordination for the special sciences and the special societies, and to keep scientific men in touch with the larger public, leaving the special programs of technical papers to the separate societies The third Philadelphia meeting and at the same time the third of the convocation week meetings held in the Christmas holidays of 1904 had a registration of 890, but the registration of members of the association no longer represents the magnitude of the meetings, as it includes only a part of those attending the sessions of the special societies. When the association was organized in 1848 its membership was 461, at the second Philadelphia meeting it had increased to 2,000, at the third to 4,000 and it is now after ten years over 8,000.

We may thus expect a large meeting at Philadelphia. But while the size of the meeting is the fact easiest to give numerically, it clearly is not the one most important. This is the men and the work they do and report. This year the meeting will be presided over by Dr. Charles W. Eliot, president emeritus of Harvard University, education—a section which was established some eight years ago—being thus for the first time recognized officially in the long list of distinguished men who have filled this office. The address by the retiring president, Dr. Edmund B. Wilson, of Columbia University, on "Some Aspects of Progress in Modern Zoology," in which progress he is the most eminent leader. The evening addresses arranged for citizens of the city are "On the Science of Musical Sounds," by Dr. Dayton C. Miller, of the Case School of Applied Science, and on "The War and the Chemical Industry," by Dr. William H. Nichols, each the one competent in the country on the subject in which he speaks. The general character of the addresses and papers before the sections can perhaps best be represented by giving the ex-



THE INTERIOR OF HOUSTON HALL.

tended list of vice-presidential addresses, which is as follows:

Vice-president Frank Schlesinger, before the Section of Mathematics and Astronomy: "The Object of Astronomical and Mathematical Research."

Vice-president Alfred D. Cole, before the Section of Physics: "Recent Evidence for the Existence of the Nucleus Atom."

Vice-president Carl L. Alsberg, before the Section of Chemistry: "Fermentation."

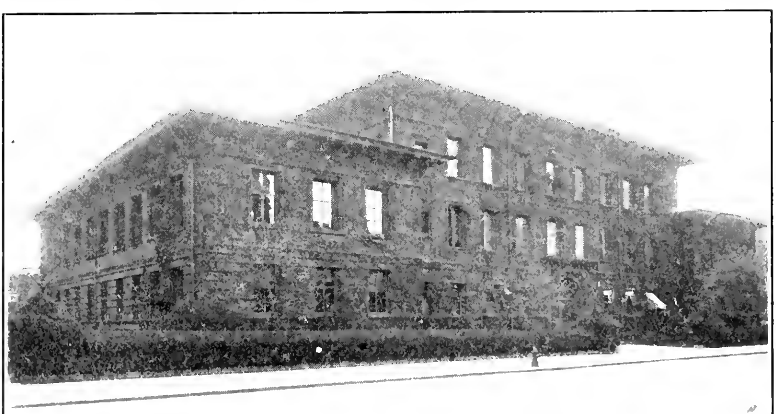
Vice-president O. P. Hood, before the Section of Engineering: "Safety Engineering."

Vice-president Joseph S. Diller, before the Section of Geology and Geography: "The Relief of our Pacific Coast."

Vice-president Alfred G. Mayer, before the Section of Zoology: "The Research Work of the Tortugas Laboratory of the Carnegie Institution of Washington."

Vice-president Henry C. Cowles, before the Section of Botany: "The Economic Trend of Botany."

Vice-president Walter B. Pillsbury, before the Section of Anthropology and Psychology: "The Function and Test



THE HARRISON LABORATORY OF CHEMISTRY.

of Definition and Method in Psychology."

Vice-president Judson G. Wall, before the Section of Social and Economic Science: "Social and Economic Value of Industrial Museums."

Vice-president Theodore Hough, before the Section of Physiology and Experimental Medicine: "The Classification of Nervous Reactions."

Vice-president P. P. Claxton, before the Section of Education: "The American Rural School."

Vice-president L. H. Bailey, before the Section of Agriculture: "The Place of Research and Publicity in the forthcoming Country Life Development."

Perhaps the most notable event of the meeting will be the organization of the new section of agriculture, before which Vice-president L. H. Bailey will give the address noted above, and there will be a symposium on the field of rural economics. But each section will hold meetings of general interest.

As attractive as the programs will be the place of meeting. The buildings of the University of Pennsylvania afford admirable accommodations for all sections of the association and the separate societies, while in themselves affording much of interest to scientific visitors. Houston Hall, which was the first club house for students on a large scale to be established at a university, offers excellent headquarters, where scientific men may meet and where committee meetings may be held. One or two of the societies will meet at the Academy of Natural Sciences, whose fine new building has recently been erected. From the time of Benjamin Franklin, Philadelphia and its institutions have been among the leading educational and scientific centers of the country. It was long our chief city for medical education and research, occupying somewhat the place in science that Boston filled in letters. The recent history of chemistry in America, by Dr. Edgar F. Smith, provost of the university and chairman of the local committee for the approaching meeting, indicates the city's leadership in that science. Other scientific centers have overtaken Philadelphia, and the University of Pennsylvania has suffered from inadequate endowment. But in recent years the growth of the university has been remarkable, and, while it may be difficult for Philadelphia to rival New York and Washington, it will surely make contributions to science commensurate with its wealth and population

THE PROGRESS IN PHOTOGRAPHY

THE history of photography is well illustrated by a series of cameras, plates, and prints exhibited in the U. S. National Museum. This collection of photographic apparatus and photographs, said to be the most complete in the world, has been collected and classified by Mr. T. W. Smillie, photographer of the museum for the past forty-five years. Work of nearly all the early inventors is to be seen, and what is said to be the first American camera, that made on Daguerre's specifications for Dr. S. F. B. Moore, in 1839.

The earliest camera, the camera obscura, used by Euclid in 300 B.C., was later improved upon by Bacon and others in the thirteenth century, and further improved by Porta in the sixteenth century. It is said that the action of light on fused silver chloride was used to make a photograph of the solar-spectrum by Scheele in 1777. Unfortunately there was then no method known for fixing the prints, and in consequence only imitations of this method are to be seen in the museum collection. Thomas Wedgwood experimented along this same line in 1802, and prepared a paper on the subject.

The first successful inquirer to secure permanent pictures through the influence of the sun's rays, seems to have been Nicephore Niepce, who in 1824 effected the process of heliography by th use of a varnish made of asphaltum, or bitumen of Judea, applied to a highly polished metal plate or a glass plate, and developed by essential oil of lavender and white pe-

troleum. The plate was exposed for several hours, the image etched, and then prints were made as from an ordinary etching. The museum collection includes one of the first permanent photographs printed from a light etched plate by the heliographic process. This print is from Niepce's plate made in 1824.

There are also several fine examples of Daguerre's work made in 1839 and later. His process, which came to be known as the Daguerreotype process, consisted of exposing a highly polished silvered copper plate, fumed with iodine, in a camera a few minutes, developing the exposed plate with mercury vapor and fixing the image with hypo-sulphite. This complex process involved five distinct operations; cleaning and polishing the plate, coating the plate with sensitive ioduret of silver, adjusting and exposing the plate in the camera obscura, developing the invisible picture after the exposure, and removing the sensitive coating so that no further change would take place in the picture. Daguerre and Niepce found that they were pursuing experiments of the same nature and went into partnership.

Six months prior to M. Daguerre's publications concerning his process, Mr. Fox Talbot communicated his photographic discoveries to the Royal Society, and afterwards issued an account of his scheme for preparing a sensitive paper for photographic reproduction which he called photogenic drawings. He prepared his paper by washing a sheet of fine writing paper with solutions of salt and silver nitrate. When dried this proved of use in securing prints of leaves, etc., in the camera obscura. Later he used iodide of potassium and other chemicals to perfect his system. Talbot's second process of paper making was patented in 1841, and was known as the calotype. The main advance in this system was the ability of the discoverer to make unlimited prints of his picture. Talbot obtained a third photographic patent on a process for photographing on unglazed porcelain, which a man by the name of Malone improved somewhat and eventually became associated with Mr. Talbot.

The museum collection, besides including many fine and unique examples of these first photographic processes, has much material on modern practical photography, including examples of different printing papers, and plates, stereoscopic pictures, flash-light paraphernalia, X-ray and colored photographs, astrophysical photographs and some early examples of moving picture making.

SCIENTIFIC ITEMS

We record with regret the death of Charles Sedgwick Minot, James Stillman professor of comparative anatomy in the Harvard Medical School, eminent for his contributions to embryology and biology and for public services in science; of Dr. Theodore Lipps, professor of psychology and philosophy of the University of Munich, and of Dr. Rudolf Emmerich, professor of hygiene and bacteriology in the University of Munich.

The Hayden gold medal of the Philadelphia Academy of National Sciences has been presented to Dr. Henry Fairfield Osborn, in recognition of his paleontological studies.—The De Morgan medal of the London Mathematical Society has been given to Sir Joseph Larmor in recognition of his researches in mathematical physics—One of the royal gold medals of the Royal Society, has been awarded to Professor Ernest Willliam Brown, of Yale University, in recognition of his investigations in mathematical astronomy

Dr. Allen J. McLaughlin, formerly of the Public Health Service, has assumed the duties of health commissioner of Massachusetts.—Dr. C.-E. A. Winslow has resigned from the College of the City of New York to become director of education in the reorganized State Department of Health.

THE POPULAR SCIENCE MONTHLY

FEBRUARY, 1915

A HISTORY OF TAHITI

By Dr. ALFRED GOLDSBOROUGH MAYER

CARNEGIE INSTITUTION OF WASHINGTON

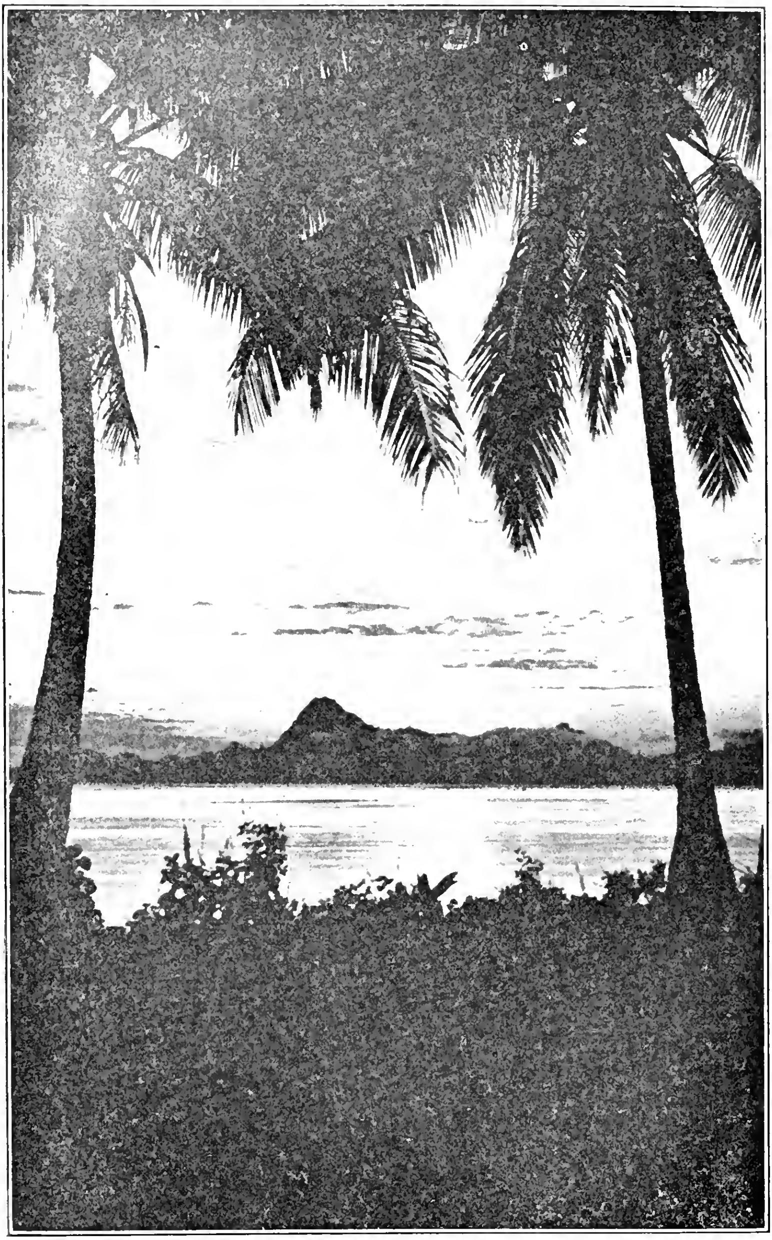
LYING far to the southward of the paths of trade and exploration. Tahiti remained unknown until in 1767 Wallis saw its splendid peaks in the course of his voyage around the world in the English frigate *Dolphin*. It is true that Pedro Fernandez de Quiros, a Portuguese captain in the service of Spain, was credited with having discovered Tahiti on February 10, 1606, but the narrative of his voyage convinces one that the low-lying atoll upon which he landed, vainly seeking water, was probably Anaa, or possibly some other island of the Paumotos, for, like his predecessors, he sought the full favors of the tropic breeze and was borne to the northward of the most beautiful island groups of the Pacific.[1]

Even to-day, sad as she lies while her native race is dying, Tahiti epitomizes the charm of Polynesia. The missionary Ellis gives us a vivid picture of his impressions as in 1817 he gazed for the first time

upon the varied picturesque and beautiful scenery of this most enchanting island.[2] We had beheld successively as we sailed along its shore, all the diversity of hill and valley, broken or stupendous mountains and rocky precipices, clothed with every variety of verdure, from the moss of the jutting promontories on the shore, to the deep and rich foliage of the breadfruit tree, the Oriental luxuriance of the tropical pandanus, or the waving plumes of the lofty and graceful cocoanut grove. The scene was enlivened by the waterfall on the mountain's side, the cataract which chafed along its rocky bed in the recesses of the ravine, or the stream that slowly wound its way through the fertile and cultivated valleys, the whole surrounded by the white-crested waters of the Pacific, rolling their

[1] See "The Voyages of Pedro Fernandez de Quiros," 1595 to 1606, translated and edited by Sir Clements Markham, Hakluyt Society Publications, London, 1904.

[2] See, "The Voyages of Pedro Fernandez de Quiros" 1595 to 1606, translated and edited by Sir Clements Markham, London, 1904. Hakluyt Society Publications.



SUNSET OVER EIMEO SEEN FROM THE SHORE OF TAHITI.

waves of foam in splendid majesty upon the coral reefs, or dashing in spray against its broken shore.

And in speaking of the Tahitian valleys, Ellis says:

> There is the wildness of romance about the deep and lonely glens, around which the mountains rise like the steep sides of a natural amphitheater, till the clouds seem supported by them—this arrests the attention of the beholder, and for a time suspends his faculties in mute astonishment, and in the unbroken stillness that pervades the whole we might easily have induced the delusion that we were upon the enchanted ground of nature's fairy land.

Even simple sailor-like Wallis says of Tahiti:

> The country has the most delightful and romantic appearance that can be imagined: towards the sea it is level, and is covered with fruit trees of various kinds, particularly the cocoanut. Among these are the houses of the inhabitants, consisting only of a roof, and at a distance having greatly the appearance of a long barn. The country within, at about the distance of three miles, rises into lofty hills, that are crowned with wood, and terminate in peaks from which large rivers are precipitated into the sea. We saw no shoals but found the island skirted by a reef of (coral) rocks through which there are several openings into deep water.

Tahiti is situated in South Latitude 17° 40′ and West Longitude 149° 25′. In other words, upon the opposite side of the world from the middle of Africa, and nearly at the center of the Pacific Ocean. In outline, it is figure-8 shaped, being a twin island, consisting of two oval land masses joined by the low, narrow isthmus of Taravao. The major axis of the island extends from northwest to southeast, and is only about 37 miles long. The larger land mass, called Great Tahiti, or Tahiti-uni, has about four times the area of Little Tahiti (Tahiti-iti) which lies to the southeastward. The total length of the coast line is not more than 120 miles, and the area of the whole island is only about one third that of the State of Rhode Island.

The peculiar figure-8 shape of the island is probably due to the activity of two originally separate volcanic cones each one of which rose above the sea until their sides touched. But, if this be true, it occurred long ago measured in terms of the life-time of volcanoes for there are now neither hot springs nor other evidences of internal heat upon the island.

Indeed much of nature's sculpturing of valley-wall and peak is due to the great variety of plutonic and volcanic rocks and nepheline syenite upon Tahiti, the differing degrees of hardness of which permitted erosion to carve deeply in some places, while at the same time leaving others to stand in bold relief.

Also the grandeur of Tahitian scenery is due to the fact that its volcanoes were of an explosive type and tore deep fissures into the earth's crust, permitting molten basalt to well upward and cement the rents. Then, when the volcanic fires died down, the rains consummated their

Morea Island Seen from Tahiti after a Storm.

work of washing away the softer rocks, leaving imposing pinnacles of hard basalt such as the sheer precipice Maiao, "The Diadem," at the head of Fautaua valley which lifts its unconquered crest thousands of feet above the soft corroding lavas of the lowlands.

In other places the valleys are spanned by dykes of basalt forming precipices over which the mountain torrents dash in a multitude of graceful cataracts.

The seductive charm of Tahiti is all its own for everywhere the beautiful is wedded to the grand. The stern crags are but nestling places for the mosses of the forest, and fascinated by the sylvan setting of the waterfall where rainbows float on mists among the tree ferns; the roar of the cataract is unperceived; and the coral reefs and shaded shores of fair Tahiti, who can forget them—the glorious sparkle of sunbeams playing over flickering ripples in a riot of turquoise, emerald, and blue is the setting of every picture—the background of every memory. Indeed, it is not where the peaks are highest that Tahiti is loveliest for nowhere in the Pacific do the mountains meet the sea in fairer grace of form and color than at Tautira on the eastern coast of Tahiti-iti. The charmed memory of Tahiti lives only to die with the beholder.

In the Hawaiian or the Tongan Islands, cup-shaped craters constantly remind one of the volcanic origin of the land, but the erosion due to ages of tropical showers has all but obliterated these in Tahiti although the broad concavity in the upper region of Papenoo valley may possibly mark the site of the great central crater of Tahiti-uni.

Nestled under the southeastern rim of this crumbling crater lies the gem of Tahiti, the lovely lake Vaihiria, in a setting of wild bananas.

guava, tree-ferns, and clambering pandanus, and shadowed by precipices towering 3,000 feet above the calm secluded waters. From afar the rivulets dash down until torn by the ragged walls they fade mostly into mist and cloud-like descend in silence to the region of the lake. Although only one third of a mile wide, the natives believed this little lake to be bottomless until our plumb line came to rest at a depth of 80 feet. There is, however, no visible outlet although huge eels glide among the water-weeds, and the mystery becomes cleared away when one goes down into Vaihiria valley where at the foot of a wall of broken rocks a cool clear stream rushes impetuously into the sunlight. In fact the little lake has been formed by a land-slide which has dammed the valley the upper part of which it now occupies.

In every feature Tahiti shows the wear of rain and weather, but still the green summit of Orohena towers 7,300 feet above the level of the sea, and 22,000 feet above the floor of the surrounding ocean. Yet the rains have accomplished much, and the almost constant land-slides show they are effecting more in their persistent work of levelling the grand peaks: and now 150 valleys wind downward from the highlands to the sea.

One is never away from the murmur of rippling water, as the mountain streams splash among moss-covered boulders that have rolled from their ancient lodgment in the cañon sides. As Bougainville wrote, these Tahitian valleys are images of Paradise upon earth. The brooks glide through arches formed by the interlacing leaves of wild banana, the "Fei" of Tahiti, while great caladiums flourish in the ever-moistened soil, and the perfume of vanilla pervades the air. Banyans form

EIMEO FROM TAHITI.

Lake Vaihiaria, Tahiti.

intricate tangles of subaerial roots though the maze of which the waters find their way, and a pretty little perch (*Dules malo*) which rises briskly to the fly disports itself within the swirling pools. Then, at last, the brook courses sluggish and spent to deposit the rich soil, the spoil of the mountain slopes, over the broad alluvial plain which fronts the sea.

Here upon the gently sloping shore-plain are the groves of bread fruit, cocoanut palms, taro and Tahitian chestnut which supported so dense a population in old days that Foster who accompanied Captain Cook upon his second voyage estimated their number at 150,000, although he was doubtless deceived by the crowding of the natives to the shore off which his ship lay anchored. Yet, certainly, in 1769 the villages were not isolated one from another as in other parts of Polynesia, but a continuous line of houses clustered along the shore, and the political unit had become the district rather than the town.

But to return to the history of Tahiti, it was on June 18, 1767, that Captain Wallis perceived the summits of its mountains rise above the sea. On the following morning as he approached the shore the tropic haze hid the island from his view, and when the rising sun dissipated the mist he was surprised to find himself surrounded by a fleet of canoes, many of them double, and 60 feet long, their carved bows curving upward high above the sea, and their pandanus-mat sails of lateen pattern. The more daring finally approached his ship, their commanders bearing clusters of banana leaves which they threw upon the deck, and a few of the more courageous natives were then induced to come on board. Pigs and chickens were recognized as familiar animals, but the sight of a goat so overcame them with fear that they leaped overboard and swam to their canoes.

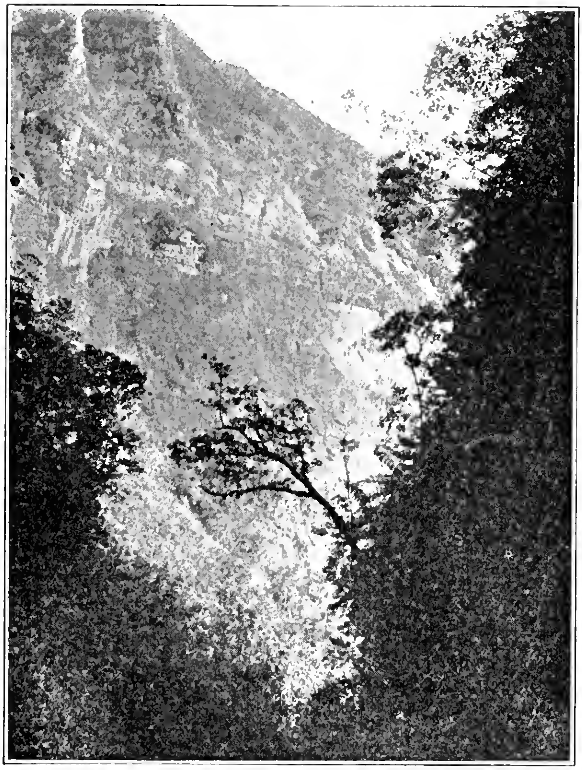
Wallis reassured them through gifts of nails and trinkets, but soon the knowledge of this vast wealth aroused the cupidity of the natives, and for days they attacked his vessel with stones hurled from slings. Finally, on the twenty-fourth of June, about 2,000 natives in 300 large canoes surrounded the ship, and when the high chief threw the crest of a palm tree into the air a general attack commenced. Wallis was forced to use his cannon, but observing that no fire came from his bows, the canoes with white war streamers flying from their sails pressed down upon him fore and aft, only to be shattered by renewed volleys. Yet so persistent were they that on June 26 the *Dolphin* was compelled to shell the shore, sending cannon shot among the houses in the palm groves before the natives broke and fled in terror to the hills. Then after more than 50 canoes in the district had been destroyed a stillness the British described as peace fell upon the scene.

The sullen silence was broken on July 11, when Purea[3] the Chiefess

[3] The "Oberea" of Cook and Banks.

or Ariirahi of the district of Papara came on board and was courteously received by Wallis who presented her with a mirror and a gown, he being under the impression that she was the "Queen" of the Island. As a matter of fact, there was no head chief whose authority was recognized over all parts of Tahiti, and Purea was merely a guest of her kinsman the chief of the district of Matavai Bay in which the *Dolphin* lay at anchor.

Greatly impressed by Purea's commanding presence and with the respect she inspired among the natives, Wallis returned the call on the



A Tahitian Valley.

following day, the natives carrying him upon their backs to the great council house, or Fare-hau of Matavai within which Purea was herself but a guest, although her actions appear to have been those which would better have graced a hostess. The house in which this remarkable reception occurred was 327 feet long by 42 wide and was a shed of palm thatch, the roof being supported upon 92 posts arranged in three rows. The "Queen" and her maidens at once proceeded to massage Wallis and his officers and finally to dress them in native garments, thus reciprocat-

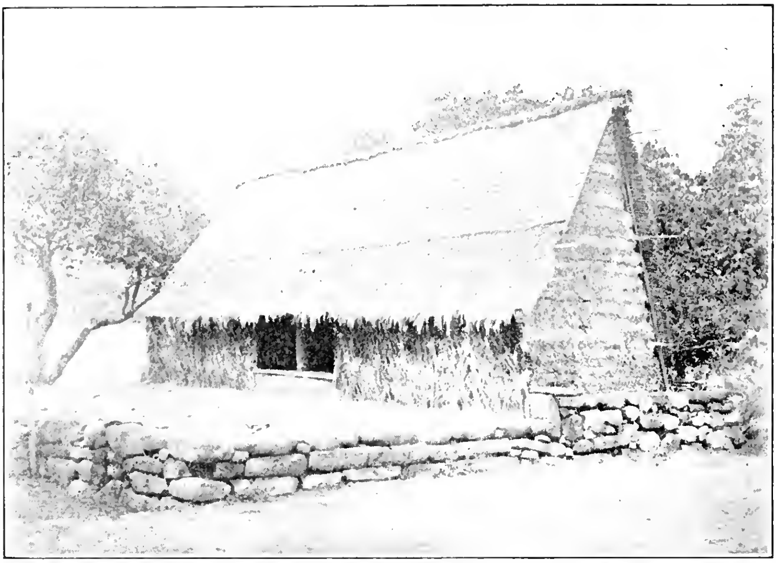
ing his own charity in presenting her with a European gown. The proceedings were, however, marred by the alarming action of the surgeon who suddenly removed his wig, causing the "ladies of the court" to flee in terror from the house.

Purea, having recovered her composure, commanded her followers to present Wallis with great quantities of bread fruit and many pigs and believing her to be supreme over the entire Island he soon persuaded himself that she had ceded her realm to him. Accordingly he hoisted the British flag, saluted it with twenty-one guns, gave each of his men a drink of rum mixed with the water of a Tahitian brook and thus solemnly took possession under the name "King George the Third's Island."

As a matter of fact, Purea was vainly endeavoring to induce Wallis to visit her own district Papara, hoping through the influence of her supernatural guest to augment her own authority, for the natives believed his ship to be a floating island filled with vindictive demons who had control of thunder and lightning; but he understood not a word, and man-like assumed that her "inconsolable weeping" was due to admiration for himself and sorrow over his intended departure. Thus on July 27 did this British Æneas depart from his Polynesian Dido never more to see Tahiti.

Soon after Wallis's departure Louis Antoine de Bougainville independently discovered Tahiti. He was circumnavigating the globe, commanding the French frigate *La Boudeuse,* and the transport *L'Etoile,* and his 200 men were worn with the sea, scurvy threatening. Happy indeed were the French when, on April 2, 1768, from a distance of fifty miles they saw the peak of Orohena, as Wallis had sighted it eight months previously. Favored by the southern trades, they sailed along the shore to anchor on April 6, off Hitiaa; there to remain for a respite of ten days. In his fascinating "Voyage autour du Monde" published in Paris in 1771, Bougainville devoted two chapters to "Taiti," or "La Nouvelle Cythère," as he officially named it, furnishing an impassioned theme for French philosophy.

Bougainville was a keen and sympathetic observer and he made the most of his time from the moment when on April 4 the canoes ventured out to his ships, their chiefs bearing clusters of banana leaves in token of friendship. A hospital was established on shore for the scurvy-ridden sailors, and most friendly intercourse was established between them and the natives, who doubtless profited by their experience with Wallis to refrain from offending the new visitors. Yet, according to Cook, an infliction worse than Wallis's cannon was turned upon the unsuspecting islanders, for the ravages of a virulent infection of syphilis followed closely upon the departure of the French. Corruption and death had entered never to leave the land, and the once gigantic race of



House of Vae Kahn, Chieftess of the Marquesas at Tae-o-hoe.

old Tahiti was to wither in a lingering decline. Fair as Tahiti was and Paradise as the French regarded it, they were the first to curse it with that infliction which "civilization" has for centuries brought upon the "savage." Sad Tahiti, land of mountain mist, and murmuring stream, of coral reef and tropic palm, and smiling skies was to be henceforth a pest-house for the simple race that knew her for their home.

From a native point of view the situation is well described in the "Memoirs of Ariitaimai" of the great Papara family of Tahiti; who says:

> For forty generations these people (the Polynesians) had been isolated in this ocean, as though they were in a modern sanatorium, protected from contact with new forms of disease, and living on vegetables and fish. The virulent diseases which had been developed among the struggling masses of Asia and Europe found a rich field for destruction when they were brought to the South Seas.
>
> For this perhaps the foreigners were not wholly responsible, although their civilization certainly was; but for the political misery the foreigner was wholly to blame, and for the social and moral degradation he was the active cause. No doubt the ancient society of Tahiti had plenty of vices, and was a sort of Paris in its refinedness of wickedness; but these had not prevented the islanders from leading as happy lives as had ever been known among men. They were like children in their morality and their thoughtlessness, but they flourished and multiplied. The European came and not only upset all their moral ideas, but also their whole political system.

But to return to our narrative. Captain James Cook, upon the first of his famous voyages visited Tahiti in the man-of-war *Endeavour,*

remaining in Matavai Bay from April until July, 1769. Cook's mission was to observe the transit of Venus, for which purpose as well as for geographical discovery, his expedition had been sent out at the instigation of the Royal Society of London. Accompanying him were such men of science as Banks and Solander whose observations upon the island and its natives at a time when they were as yet unspoiled, have given us the classic account of a primitive Polynesian community, supplemented as it was in 1829 by the scholarly volumes of "Polynesian Researches" written by the great missionary William Ellis.

At the time of Cook's visit, Tahiti was a characteristic Polynesian feudalism, the Ariirahi, or principal chiefs, being dependent for sustenance and political support upon the landed proprietors, the *bue raatira*. But in Tahiti as elsewhere in Polynesia, the supreme chiefs of districts were believed to have descended from God-like heroes of the myths, and their persons were held as sacred, thus greatly strengthening their position in time of political crises.

In acknowledgment of their feudal position, the large landed proprietors or Arii called themselves "the stays of the mast" by "the mast," signifying the Ariirahi, and as elsewhere wherever feudalism has been the social order, the incessant rivalry between nobles had forced the common people to flock to the standards of the few who could best afford protection, and in consequence the Arii, or "baron," of a Tahitian valley might become more powerful in his own domain than was the Ariirahi over the district as a whole. Thus an unstable form of "limited monarchy" was maintained in each district and to secure the suc-

PANDANUS TREE ON THE LAGOON BEACH OF FAKARANA ATOLL, PAUMOTES.

NATIVE OF THE SOCIETY ISLES IN TAHITI.

cession from usurpation, the son of the high chief was granted the family title immediately upon birth, and his father who was the first to do him homage, was nominally at least reduced to the rank of a vassal. Before the missionaries came there was never a "king" whose authority was recognized over all Tahiti, but so great in outward form was the respect paid to the Ariirahi that people who passed their houses or came into their presence removed all clothing to the waist, an act of homage they paid also to the images of gods. The Ariirahi's feet might not touch the ground in any but his native district for all he trod upon became his own. Accordingly, when abroad he was carried upon the back of a retainer, and it was the boast of Pomare that he was greater than King George for he of Tahiti rode upon a man while the king of England was obliged to content himself with a horse.

In their marital relations the Tahitians closely approached the primitive condition wherein all the women are the wives of all the men. The wife of every man was also the wife of his friend, and it is probable that a more licentious race never lived during historic times. As Cook's narrative states, topics which with us are avoided were the chief theme of conversation among the Tahitians.

As elsewhere in Polynesia, rank descended through the mother and for the purpose of maintaining their exalted state, the great chiefs intermarried only among their own kindred, but such alliances were merely temporary, for after the birth of a legitimate heir, women of high rank consorted without scandal with endless paramours, although all their children of uncertain parentage were immediately put to death. In fact, infanticide was established not only as an accepted, but as a lauded institution in Tahiti; and according to Ellis two or three children constituted an unusually large family, and practically every woman had with her own hands murdered some of her own offspring, probably two thirds of the children born in Tahiti being thus disposed of immediately after birth.

In the absence of fatal epidemics and with the ever-present danger of famine through over-population, such barbarous checks upon increase had grown to be considered virtuous, and furnished the tenets of the society of Areoi, said to have been established in remote times by the followers of two celibate gods who although they did not enjoin chastity upon their worshipers prohibited their rearing offspring. Thus these bacchanalians of the Pacific roamed singing and dancing, welcomed everywhere as wits and entertainers; transient spirits flitting through the world each to die the last of his race on earth. They constituted a large proportion of the population, for in Cook's narrative we read of a fleet of 70 canoes filled exclusively with Areoi.

Cannibalism was unknown in Tahiti at the time of its discovery, yet here as elsewhere over the Pacific traces of its having been were there,

A Tahitian Carrying Bunches of Wild Plantain "Fei." The man had come several miles down the mountain side bearing this enormous burden.

for tradition stated that two mythical brothers, the Taheeai, were cannibals but were finally killed through trickery by a Tahitian Hercules, greatly to the joy of all men then living. Also at the time of Cook's visit, the eye of the human sacrifice was placed within the lips of the high chief, and the original name of the late "Queen Pomare" was Aimata, "the eye eater."

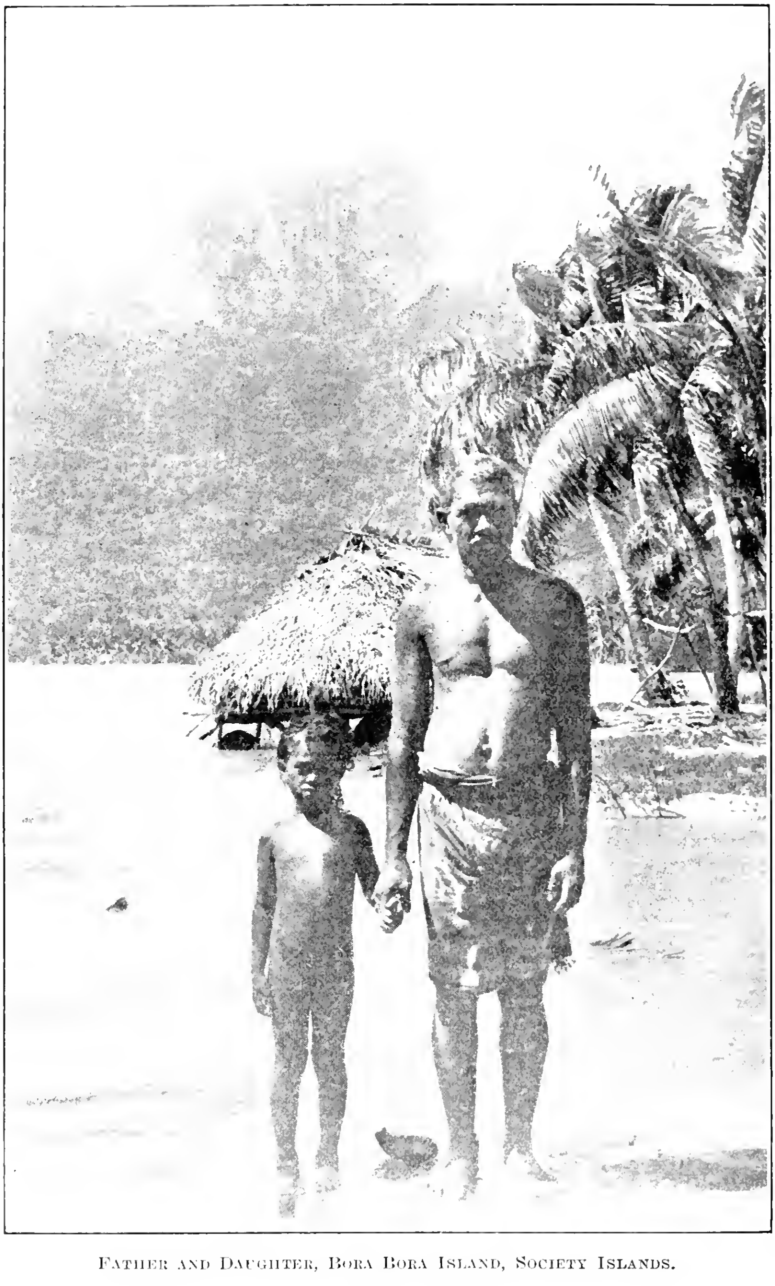
As with the Aztecs, these sacrifices appear to have become more numerous immediately succeeding the coming of the white man. Criminals, or slaves who were captives taken in war, were immolated in times of public ceremony as upon the occasion of the inauguration of a new Ariirahi, but the common sacrifices were pigs whose bodies were left to decompose upon the altars as food for the gods who came in the form of carrion birds.

As elsewhere in Polynesia, the worshiped beings were the spirits of

departed ancestors, for to the simple mind all things of nature are of his own kindred, the world was made by a man-like god for man and all things centered round him. Thus the sun was a ghost that plunged beneath the sea at night, the moon was the sun's wife and the stars their children, and every waterfall, mountain peak and valley had its guardian or haunting nymph or good or evil spirit. The ceremonies associated with the worship of the ancestral spirits were usually conducted upon the roof-shaped heaps of stones called the marae which each Arii caused to be erected in his district, each of his retainers contributing two stones to the structure. Cook states that the marae of the high chiefs Amo[4] and Purea in the district of Papara was a prism with an oblong base 267 feet long, 187 feet wide and 44 feet high, having eleven steps or terraces broader at the sides than at the ends. The top was a ridge resembling the roof of a house and at its middle point stood the image of a bird carved in wood while near it lay the broken model of a fish cut in stone. The sight of this stupendous structure, and the statement that each person in the district had contributed two and only two stones may have caused Cook to form his exaggerated estimate of the population of Tahiti. Shapeless and sadly reduced by burning in a lime kiln, the marae of Papara now lies forgotten in the forest by the

MAKING FIRE IN TAHITI, by rubbing two dried sticks of the yellow hibiscus one against the other.

[4] Amo, the "Eamo" of Cook's narrative, was the son of Tuiterai (God of the sky).



Father and Daughter, Bora Bora Island, Society Islands.

sea. Yet even to-day the ruins of about 40 maraes are still to be found upon Tahiti and Eimeo.

Such, in brief, were the Tahitians, that race of giant men who came to welcome Cook with leafy boughs within their hands—tokens of peace and friendship. And a friendship real as any that can be formed between the weak and the powerful grew up between the great Englishman, whom they called "Toote," and these careless, light-hearted children of the Islands of the Sea. It is of curious interest, however, to observe that intimate as Cook became with his Tahitian friends, he never learned the true name of the Island, his word "Otaheite" meaning "From Tahiti"; Bougainville's "Taiti" especially as the "h" is softly sounded, being far nearer the correct representation of the name.

Without attempting to minimize the barbarity of their customs, let us not permit ourselves to be over harsh in condemning the Tahitians. A primitive race cast far from their original home upon a small island remotely isolated; without iron or metals, or clay for pottery, and living in a warm seductive atmosphere that soothed ambition into somnolency; it is much to their credit that Cook says of them that they were cheerful, generous, cordial, and brave, and Ellis states that theft and crime were of rare occurrence. Such indeed is the consensus of opinion among Europeans who, though not missionaries, lived among Polynesian peoples during the days when they were unspoiled by contact with civilization. In Mariner's fascinating account of Tonga, and Melville's charming story of Typee in the Marquesas we find far more of praise than of condemnation.

Let us remember that practically nothing of invention, art, literature, science or constructive leadership has come from the untold millions of our own race who have been born and bred and spent their languid lives within the torrid heat. Great men such as Hamilton, the first Dumas, or Kipling have, it is true, been born in the West Indies or in India, but their education and achievements were attained in colder lands. The history of the British in India is replete with the tragedy of broken hearts, and every ship bound "homeward" bears its freight of exiled children whose fate it is to become strangers to their duty-loving parents. This uncounted toll of the dull, monotonous, never-ending heat, how different would history have been had our race been born to withstand its merciless suppression.

Just as the first fruits of the renaissance were ripening in Spain, a vision of the Indies came like a mirage from afar to lure onward the ablest of her youth. Into regions unknown they went never to return, and they and their descendants were lost to intellectual Spain. Thus was her best blood wasted and the leaders who might have been were unborn. Spain depleted, drained of her strength, and with too few at home to win the great battle of liberty, withered under the fires of

the inquisition. It was the tropic heat, the infection of the mosquito-haunted swamp, and the demoralizing contact with tropical populations that conquered Spain, not the fleets of the English, for it was years after the tragedy of her great Aramada that Spain's greatest things in art and literature appeared.

Indeed, England herself narrowly escaped the same fate which would have been hers also had she succeeded in supplanting the Spaniard on the mainland of tropical America. Unable to accomplish this, she was perforce obliged to colonize in the neglected north, and the bleak shores that gave her first adventurers so inhospitable a welcome in time became centers of civilization, advancing her culture and her empire over the sea.

Cook returned to Tahiti in 1773 and again for the last time in 1777, and then for eleven years the Island saw no European vessels until October, 1788, when the cry "Ephai! ephai!!" (A ship, a ship!!) echoed along the rocky shores. It was the *Bounty* under Lieutenant William Bligh, R. N., and her mission was to gather young bread-fruit trees in order to introduce this coveted plant into the British West Indies.

Bligh, although a brave and efficient navigator, made himself odious to both his officers and his men, his conduct being that of an irritable, selfish, suspicious tyrant, and much as his men feared him, they hated him even more.

Yet for nearly six months, during which the ship lay moored in Matavai Bay, there was solace for her crew in the wanton pleasures of the tropic isle, and when on the 4th of April, 1789, the anchor rose for the Bounty's last farewell, many a heart was aching under the sailor's blouse and many a dark-eyed maiden watched weeping from the shore.

If Bligh's ugly temper had been trying in the past, it became even more annoying after he left Tahiti. On the 27th of April when off the Tongan Islands, he burst forth into a tirade of abuse, unjustly accusing his officers, and especially his first mate, Mr. Christian, of petty thefts of food.

Throughout the night the *Bounty* lay upon a calm and glassy sea, her sails flapping to the long, low, ceaseless heave of the Pacific, and young Christian, burning under his wrongs, paced hotly on his watch while the ship and all on board lay sleeping.

In the gray of the listless morning before the glaring eastern sun had shown upon the sea, his resolve was taken and the die of Britain's most noted mutiny was cast. Hastening to the forecastle his word was as a spark to gunpowder to the repressed spirits of the crew. Amid deep muttered cursings, the gun chest was torn apart, and Bligh awakened to be led upon deck, his hands tied behind his back. The ship was in dire disorder with mutineer sentinels standing before the cabin doors

of such officers as might have come to their comamnder's aid, but obedient to young Christian's orders, the *Bounty's* launch, a boat only 23 feet long, was lowered, and Bligh and 18 of his men were forced over the side crowding the frail craft until the gunwale was but seven inches above the level of the sea.

But mercy came to temper the fate of those who were to be sent adrift. A hundred and fifty pounds of bread, some water and some wine, a little pork, charts, a sextant, a compass, and a few cutlasses were thrown into the boat. Guns the mutineers refused, and then the commander and his faithful few were cast away.

As if in exultation the *Bounty* awakened to the impulse of the morning breeze and glided off upon the rippling sea while from the throats of her ruffian crew the cry arose "huzza for Otaheiti." As the cheer came over the waters, it brought to Bligh a sense of high resolve to make the best of the narrow chance for life and home that lay before him and his men. But Christian, the mutineer, they say stood moodily with folded arms, his eyes fixed upon the drifting boat which stood for all that remained of law and order on the wave.

A gentleman by birth and training, he might have risen high, an honored servant of his country. Too late the villain cheer revealed to him the dark import of his vengeful act. An outcast he must be forevermore. In a world apart from Europe he must live, and memories of youth and home and friends of other days rose up to curse him as he sailed, archpirate as he was, into a life of wantonness and ruin.

The volcanic peak of Tofoa, one of the Tongan Islands, rose dimly above the northern horizon and toward it Bligh and his men set oars and sail hoping to increase their scanty store of food and water. In this they were foiled for the natives seeing them helpless attacked them with stones, killing one and wounding all so that they considered their ultimate escape fortunate. On and on they sailed for dull days and nights, and always onward until they passed through the uncharted Fiji group and discovered the northern New Hebrides, never daring to land though they suffered all the pangs of starvation. Two meals a day each consisting of $\frac{1}{25}$ of a pound of bread and $\frac{1}{4}$ of a pint of water were all stern Captain Bligh allowed, for his destination was Timor, full 3,600 miles from Tonga. His journal describes their suffering in minute detail, and one must respect the courage and resourcefulness of the leader who cheated death a hundred times in the course of this awful voyage. Through starless nights of storm, bailing constantly, fighting the overwhelming sea, shivering in the rain, blinded by the roasting eastern sun, racked with pain, cramped almost beyond endurance as they crouched sleepless within the boat, they still went on and on and each returning noon saw them nearly 100 miles nearer to Timor.

Occasionally they succeeded in seizing the gulls which flew near the

boat, and each such prize was cut into 18 pieces and devoured. Many sea-snakes were seen but it did not occur to Bligh to use them for food.

One dark and stormy night they heard the roar of breakers close aboard and narrowly escaped being dashed to death upon the Great Barrier Reef of Australia. On the following day, however, they succeeded in sailing through a narrow opening in the reef, elated to find themselves upon smooth waters under the protection of the coral flats. Here they ventured to land upon several small deserted islands where they feasted upon shellfish, replenished their store of water, and above all, enjoyed the luxury of sleep.

Then on they went through Endeavour Strait growing daily weaker upon their reduced ration. Finally, on June 14, 1789, the people of the Dutch village of Coupang on Timor were horrified at the appearance of 18 ragged wretches reduced almost to skeletons who staggered and fell upon the shore while tears of joy streamed down their weather-beaten cheeks.

For 47 days Bligh had sailed across 3,618 miles of almost uncharted ocean, passing dreaded islands of the Fijis and the New Hebrides, surmounting not only the perils of the sea but even greater dangers from murderous cannibals, and his courage as a leader, and skill as a navigator must inspire respect as long as the annals of Britain's navy are cherished as a record of heroism.

But to return to Christian and the *Bounty* whom we left on that fateful morning of the 28th of April, 1789.

Christian knew full well the skill and resource of Bligh and foresaw that should the cast-off commander reach England, Tahiti would be but a death-trap to the *Bounty's* pirate crew. He therefore set his course for the small island of Tubuai, one of the Austral group, about 250 miles south of Tahiti. This lonely spot had been discovered by Captain Cook in 1777, who observed that the natives spoke the Tahitian dialect and appeared to be industrious cultivators of the soil.

Upon the *Bounty's* arrival, they crowded in great numbers to the shore blowing their triton war horns and brandishing clubs. Christian therefore changed his course for Tahiti, where his old friends warmly welcomed the *Bounty* and her crew. Here, however, he remained only long enough to supply his ship with provisions and live-stock, and together with a number of his Tahitian friends he sailed again to Tubuai, this time to be hospitably received.

A criminal in the eyes of civilization, Christian maintained until his death the respect of his lawless crew. They addressed him always as "Mr. Christian" and the generous spirit he displayed in sharing every hardship, no less than his real ability as an executive, showed that had he remained faithful to his country he might have died an admiral of the blue. As it was, he took his part in the immense labor of construct-

ing a fort at Tubuai, digging himself within the moat which encircled the parapet with a depth of 20 feet. But control the innate passions of his ruffian associates, he could not. Their brutal disregard for human rights brought on a war of extermination between the natives and the whites in which Christian himself was severely wounded. Finally, despairing of the impossible task of restoring order, he yielded to the murmurs of his men and returned once more to Tahiti.

Here, late in September, 1789, the *Bounty* anchored for the last time and most of her crew deserted to plunge into the riotous pastimes of the shore, while Christian with eight comrades remained on board. Twenty natives, men and women, joined them, and then early in the morning of September 23, Tahiti awakened to watch the *Bounty* fade from sight beneath the northern horizon.

The expected came to pass, for on March 23, 1791, the British frigate *Pandora* bore down upon Tahiti and those who survived among the mutineers became captives chained to her decks beneath the torrid sun.

But where was Christian and the *Bounty?* For three months the avenging *Pandora* searched in vain, for, like the fate of La Perouse, that of the *Bounty* had become but one more mystery of the Pacific.

Yet there was intelligent method in Christian's leadership. He knew that one day upon Carteret's voyage in 1767 a young midshipman named Pitcairn had seen from the masthead something which appeared to be a barren rock projecting high above the sea, and Captain Carteret had named it "Pitcairn Island." Three weeks Christian spent searching for this isolated land, and at last when almost in despair he found it nearly 180 miles from the longitude assigned by Carteret, but all the safer for a last retreat.

Lost in the vast ocean, far from the paths of man no spot in all the island world was more remote than this tiny islet with its sheer precipices frowning down from eleven hundred feet upon the sea, while back of the volcanic walls concealed from the view of ships, there lay a valley rich in palms and tropic trees. A slight indentation in the bold and unprotected shore marked the last anchorage for the fated *Bounty* ere they sank her far from sight beneath the sea.

Christian divided the island into nine parts assigning one to each of his men and to himself, while the natives became wives and servants to the whites.

And Christian who had fled from all, now fell under the sad shadow of his thoughts. Long hours he brooded sullen and alone within a cave that looked upon the sea and here he read his Bible through and through, yet what availed a mumbled creed to one whose life was blasted such as his! A worthy servant of his king and country, he might have been but for a moment's work conceived in rage. All romance of his wild career

sank down to the dull lusts of savagery's desires. Uncheered he heard his dark-skinned offspring romp and play and sport among the breakers of the shore, their mother's wanton spirit over all. A family worthier of his gentle name he might have reared in England, had he not in the exultation of revenge bartered his birthright to civilization. And lonely Pitcairn lost upon the sea was but a prison for his starving soul where he must languish through a waste of years, his sole alternative oblivion or the hangman's rope.

Feuds bitter, unreasonable and prolonged arose on Pitcairn, and Christian soon was shot, and before ten years had passed midshipmen Edward Young and Alexander Smith were the sole surviving mutineers upon the island. Then a strange change came over Young, who appears to have been a weak, rather than a vicious character. He determined to devote his remaining days to elevating the standards of the entire community. The Bible and Prayer Book that had belonged to Christian were recovered from the cave where they had lain for years neglected, and thus the last of the ill-fated crew turned missionaries and school teachers to the women and children of the colony. In 1800, Young died, his end being unique in that his death was due to natural causes. Thus Smith became sole guardian of this strange community, winning as years passed their love and veneration; for, indeed, he stayed the hand of rage and imparted to the rising generation true principles of civilization.

Nearly twenty years had come and gone and the world had forgotten the *Bounty* in the stirring events of the first decade of the nineteenth century, when one day the American ship *Topaz* under Captain Folger of Nantucket discovered an uncharted island, and a boat manned by brown-skinned English-speaking youths came out to welcome him. Thus was the retreat of the mutineers revealed; Alexander Smith, or "John Adams," as he now called himself being the sole survivor of the *Bounty's* pirate crew; and he lived the revered leader of the islanders until his death in 1829 at the age of sixty-five.

The coming of the *Bounty's* mutineers to Tahiti in 1788 was an event of primary significance in the history of the island. Hitherto Tahiti had been a community of feudalisms, the power of the Ariirahi being constantly checked by the contending claims of rivals; but here as elsewhere over the South Seas, the coming of the white man tended at first to increase the power of the chief they came most in contact with though finally it led to the utter ruin of all native leaders including the "king" himself.

The head chief of the District of Pare in 1789 was Pomare, the nephew of Purea, now grown to manhood. Cook had known him as "Outou,"[5] but upon hearing his little son cough at night he had changed

[5] Otoo's real name was Tunuicaite-atua, signifying descent from the gods.

his own name to Pomare (night cough). He was now in his prime and six feet four inches in height, and armed with a huge club, he was well equipped to inspire terror among his subjects.

Pomare enjoyed the immeasurable advantage of being chief of the region of Papeete (the water basket), for this having the best harbor of the island enabled him to gather enormous fortunes of nails, hatchets, and red feathers from ships, only, however, to be robbed by his rivals upon the departure of his European friends. Thus when the *Bounty* came to Tahiti he was in the direst straits having been forced to "declare dividends" for the benefit of every other Ariirahi of the island. However the sixteen mutineers marooned upon Tahiti found it to their advantage to aid Pomare, and they turned their guns upon his rivals with such cruel slaughter that in a few months he was tyrant not only of Tahiti but of the island of Eimeo. Probably it was fortunate for his schemes that no sooner was his tyranny secured than the avenging *Pandora* came to capture and remove his villainous assistants, who doubtless would in the end have murdered their royal master.

This period wherein one of the high chiefs secured the services of unprincipled white men armed with guns had its parallel in Fiji where it led to the rise of Mbau; in Hawaii it enabled Kamehameha to conquer the entire archipelago; and in Tonga, aided by Europeans, it secured the preeminence of George Tubou.

As in the wars of the roses, the leaders suffered more than the people in these bloody raids for power, and thus the commoners, their local overlords being slain, began to rise in influence, and something akin to public opinion commenced to murmur as a growing check upon the tyrant who now assumed the rôle of autocrat whereas formerly he had been but a moderator. Thus in old times, generosity was considered to be an Ariirahi's highest virtue, and often he gave so lavishly of the tribute he received that in worldly goods he was poorer than many a servant in his train.

(*To be continued*)

POPULAR MISCONCEPTIONS CONCERNING THE WEATHER

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THE weather is perhaps the most widely discussed of all topics of conversation. It is not unnatural that it should be of such general interest, since every man living upon the surface of the earth is influenced by this feature of his environment. Moreover, atmospheric air is itself one of the elements necessary to sustain human life. So commonplace a subject as the weather, therefore, needs no definition. Ever since man first appeared upon the earth the weather has been an ever-present influence—its changes have affected his actions as well as his very mode of life. It is only during the past century, however, that any real progress has been made in a scientific knowledge of the weather, the influences to which it is subject, and the effects resulting therefrom. Only a beginning has thus far been made in that direction. Meteorology, the science of weather, and climatology, the science of climate, have progressed slowly, and for this reason various misconceptions and superstitions concerning weather and climate have persisted even to the present time. While much is still to be learned about the atmosphere it is already possible to disprove many of these false notions. It is the purpose of this paper to enumerate and briefly to discuss twenty-five of the more common of these misconceptions. No new facts will be presented—the aim simply being to make clear the fallacies underlying these misconceptions in terms of principles generally accepted by meteorologists and climatologists.

The supposed influence of the moon, the planets or the stars is probably the most widespread of all popular misconceptions about the weather. Manifestations of these fallacies are seen in a great variety of ways, including long-range forecasting, the planting and the harvesting of crops, and various events in the husbandry of cattle during periods determined by phases of the moon, etc., all of these being examples of a belief in the relation of heavenly bodies and human affairs. The textbooks in geography still used in many of the common schools frequently combine a brief discussion of astronomy and meteorology in the introductory chapter, thus laying the foundation for considerable confusion in the minds of the children. Moreover, the ancient science of astrology still has a few disciples among the uninformed, as far as the weather is concerned. Meteorologists, however, are now unanimous in the opinion

that the influence of the moon, the planets and the stars (not including the sun) is practically nil, when terrestrial weather is considered. It should be remembered, in this connection, that heat is the fundamental force determining weather—the form of energy outweighing all others combined. When it is stated that the sum total of all the heat energy received from all heavenly bodies (not including the sun) is so slight that one of the most delicate of instruments is required for its measurement, it is apparent that their influence upon our weather is negligible. The moon, about which most misconceptions of this character center, is without doubt the direct cause of ocean and atmospheric tides, and there are places along certain coasts where ocean tides produce periodic tidal breezes. Aside from the indirect effects here enumerated astronomical influence upon weather is practically of no consequence. The untruth of the proverb which states that the moon tends to drive away the clouds is explained partly by the fact that a clearing of the sky at night is not ordinarily observed unless the moon is above the horizon, and partly by the fact that after sunset there is a cessation of the ascending currents which result in the formation of clouds of the cumulus type, the clouds already formed soon dissipating.

Contrary to a fairly general impression, there is no apparent relation between earthquakes and the weather. Scriptural allusions to destruction of life and property often associate earthquakes and violent storms as though they were of common origin, and the idea has persisted, to some extent, even in modern writings. In general, it may be said that earthquakes are caused by forces at work within the earth, or at least beneath its surface, such as the slipping of the crust along a fault plane, or the movement of molten matter or steam beneath the hard crust. On the other hand, weather changes result from the effects of forces at work within the atmosphere itself, primarily as a product of energy coming through space from the sun. Various investigators have attempted to discover a relation between barometric pressure of the atmosphere, earth tides and local disturbances of the crust. Aside from this possible indirect relationship there is no known coordination of earthquakes and the weather.

Nor is there any marked relation between magnetic phenomena and the weather. Magnetic storms, or disturbances in the magnetic state of the earth, frequently occur without any apparent effect upon the weather. That there is a relation between magnetic phenomena in the earth, auroras, and solar disturbances, particularly sunspots, there can no longer be any doubt. The aurora borealis, seen in northern latitudes, and the aurora australis, seen in southern latitudes, are believed to be caused by electrical discharges in the rarefied strata of the earth's upper atmosphere. Aside from the visible manifestations of such discharges, observers have sometimes noticed sounds, and, upon rare occasions, odors

which were thought to have resulted therefrom. However, the aurora has not yet been satisfactorily explained. With the exception of the aurora, there is no known relation between terrestrial magnetism and atmospheric phenomena.

The question as to whether or not forests affect weather and climate has been much debated. Recent investigations have brought out the following facts: Whatever influence forests have upon meteorological conditions is purely local, and even that influence is not marked. In one case it was found that the mean annual temperature within a forest was only a few tenths of a degree cooler than at a point a half mile or a mile outside the forest border, the greatest difference amounting to 2° F. The relative humidity was at times 7 per cent. greater within the forest than in the open country. In the United States the wholesale destruction of forests, which has been going on since colonial times, has not been accompanied by any marked increase or decrease in rainfall. On the other hand, the reforestation of large tracts in central Europe and in northern Africa during the past century has not resulted in an appreciable effect upon the precipitation observed during that period. Forests are the effect rather than the cause. There is still considerable confusion in the public mind concerning rainfall and flowoff, when the supposed influence of forests is considered. Deforestation has undoubtedly increased the frequency and the intensity of floods in small constricted districts, notably in certain mountain valleys, but where the removal of the forest cover over large areas has been followed by cultivation of the soil the rate of flowoff has remained unchanged. From hydrographs of the principal rivers of the United States it is apparent that high waters are neither higher nor low waters lower than they were fifty years ago, and they are neither more frequent nor of longer duration now than they were then. Notable floods like that of Paris, France, during the spring of 1910, and that of the Ohio Valley in the spring of 1913, are the result of a number of causes, in which the excessive rainfall was in no way related to the presence or absence of forests, and in which the rapid flowoff was more dependent upon the frozen soil than upon the recent removal of the forest cover. That the flowoff is more rapid when the ground is frozen explains the greater frequency of floods during spring than during any other season of the year. Moreover, forests tend to preserve the snows of winter, as well as to retain the fertile elements of the soil from washing away. While forests are thus of importance to the agriculturalist and the engineer, they are of little concern to the student of the weather.

The deep-seated notion, held by many individuals, that the climate is changing is often referred to in expressions like "old-fashioned winter," "the storms we used to have," and "the deep snows when I was a boy," etc. Subjective phenomena like these are of inter-

est to the psychologist, and it remains for the meteorologist simply to prove that the notions have no basis in fact. When one plots the seasonal or the annual temperatures or snowfalls, or any other elements of climate, using reliable records as far back as they are available, it is apparent that the curves show no appreciable change of climate within the life of any man now living. The explanation for fallacies of this nature must be given in terms of psychology. Present winters do not seem to be as severe as "old-fashioned winters" because of better housing and heating conditions, more efficient clothing, improved methods of transportation, with multiplied comforts and conveniences. The retired farmer living in a steam-heated city apartment building in which there are double windows is apt to exaggerate the severity of past winters when he may possibly have seen the snow drift through cracks in a log house. Moreover, a snowfall of three feet looks considerably deeper to a boy four feet tall than it does to him when he becomes a man six feet in height.

There is no known relation between the weather of one season or year with that of the following season or year, various opinions to the contrary, notwithstanding. The records of the Weather Bureau do not show that a relatively dry spring is followed by an unusually hot summer, or that an abnormally cool autumn is followed by a severely cold winter. Neither can it be shown that cold years or warm years occur in groups of two or three, as is sometimes maintained. While well-marked cycles are recognized in various solar disturbances, particularly sunspots, there is no similar cycle apparent in the weather of seasons or of years. If there are cycles in the weather they must be measured in terms of tenths of units, and they are therefore of no practical importance.

Neither is there any indisputable connection between the weather of one day and that of subsequent weeks or of seasons. Tradition has it that the presence or absence of sunshine on Groundhog Day, February 2, determines whether or not winter conditions shall continue during the following six weeks; that a showery Easter Sunday is followed by seven showery Sundays; and that a rainy St. Swithin's Day, July 15, portends forty consecutive days of rainfall. No basis can be found for these traditions in available records. True it is that springlike conditions come considerably earlier some years than during other years, but such conditions are not related to the weather of February 2. Moreover, spring and summer are the seasons of greatest and most frequent rainfall over the central portion of the United States, but the frequency of rain is not related to the conditions prevailing on Easter Sunday or on July 15.

In the use of the terms cyclone and tornado there is considerable confusion, and the terms are used indiscriminately. As used by the Weather Bureau the term cyclone refers to an area of low barometric pressure with winds blowing counter-clockwise and spirally inward

toward its center, or point of lowest pressure. Marked "Low" on the weather map, the cyclone is variously called storm, depression, or disturbance. Cyclones vary greatly in size, some being as large as the whole Mississippi Valley, while others are no larger than New England. In the United States they usually move from west to east at an average rate of 300 miles a day, the rate being faster in winter than in summer. In general, the wind velocity varies directly as the barometric gradient, that is, the rate of change of barometer as measured outward from the center. Cyclones are regions of clouded sky, with more or less precipitation, and as they pass alternately with the "Highs" in endless procession across the northern and central portions of the country they produce the frequent weather changes which are characteristic of these regions. In winter, when they are most common and follow the more southerly routes, they bring warm weather at the front and cold weather at the rear. A tornado, on the other hand, is a violent local storm of the thunderstorm type, with whirling and ascending winds of extremely high velocity, causing destructive effects over paths varying in width from a few feet to a few miles. They occur during the summer half-year only, and usually during the hottest part of the day. Not only are they always associated with thunderstorms, but they may be considered overdeveloped storms of that class. While cyclones and tornadoes thus have many common characteristics, custom has identified the use of the terms with certain meanings. Cyclone, as a general term, refers to any whirling mass of air, while tornado, the special term, refers to a particular kind of whirl. However, as used by the Weather Bureau their application is that described above.

The frequent expression in winter that "another storm is brewing at Medicine Hat" seems to be based upon a false association of that station with the origin of our weather. Charts of the weather of the whole northern hemisphere, now made daily at the central office of the Weather Bureau at Washington, show that the cyclones and the anti-cyclones which determine our weather move from west to east in endless procession. Some of the individual areas may be followed throughout the entire circuit around the earth, while others can be traced for only short distances. Neither Medicine Hat nor any other single station serves as a starting point. However, well-defined storm tracks are now recognized. Certain stations in the Canadian northwest are closely watched for indications of an oncoming storm, which, if it follows the usual route, will enter the northwestern states one to three days later, subsequently passing eastward and finally passing off the Atlantic coast. Because of their positions on the storm tracks, and not because of any center of storm formation, should stations like Medicine Hat be of meteorological interest.

What is popularly known as the equinoctial storm is supposed to

occur about the time of the autumnal equinox, September 21, when the sun crosses the celestial equator to the southern hemisphere. East of the Rocky Mountains rain occurs on an average about once in three or four days, while in the North Pacific states it occurs once in every two or three days, taking the year as a whole. Throughout these large areas the latter part of September is a transition period, with autumn conditions replacing those of summer, and occasionally with the first occurrence of a storm of the winter type. The latter are usually characterized by relatively high winds, rain on two or three successive days, and followed by a considerable fall in temperature. Bearing in mind the average frequency of rainy days and of winter storms, it is apparent that it would be abnormal should no rain occur during the week preceding or the week following September 21. The so-called equinoctial storm is a fiction.

Indian Summer is another popular superstition. Characterized by high temperatures, light winds and calms, and a hazy or smoky atmosphere, it is generally supposed to be a particularly pleasant period of indefinite length occurring in October or November. That there is frequently a return of summer-like conditions during the late autumn can not be denied. But to affirm that Indian Summer is a period of several weeks in duration, recurring each autumn, and easily recognized by the occurrence of heat, calms and haze, can not be proved by climatological records. It is a peculiar fact that while the recurrence of summerlike conditions in autumn has given rise to this tradition, and even the name as a season, the similarly frequent recurrence of winterlike conditions in spring has not been popularly recognized. Summerlike periods in autumn and winterlike periods in spring can in every individual case be explained by the weather map in terms of barometric distribution, paths of storms, resulting winds and calms, the height of the sun, the length of days, and the unequal distribution of heat over the continent and the bordering oceans.

Another false notion, particularly common in rural districts, is the belief that various animals, through some particular dispensation of Nature, have a previous knowledge of coming weather changes. As a result, many proverbs have arisen, based upon observations of the behavior of animals. For example, it is sometimes stated that a cold winter is portended when the musk-rat or the beaver builds the walls of his home thicker than usual, or when the squirrels or the non-migratory birds hide large quantities of food during the autumn. Again, the remark is often made that a storm is imminent when the chickens go to roost early or when the house-cat seeks a warm place beside the fire. Even the human feeling of comfort occasionally gives rise to presentiment. Persons afflicted with recurrent rheumatism claim to feel the approach of a storm long before it appears, and people of

nervous temperament often affirm that they have forebodings of coming thunderstorms or of rainy spells through a temporary disturbance of their neural equilibrium. Physiologically considered, either from the point of view of man or of the lower animals, these fore-warnings, often verified, have some basis for their existence. The secret of the explanation probably lies in the fact that all weather changes occur in cycles—that is, a more or less constant order of events accompanying every change. With the summer thunderstorm this cycle usually consists of the following: rising temperature and humidity, pressure oscillations, decreasing winds, increasing potential of atmospheric electricity, thickening clouds and consequent growing darkness, distant lightning, rumbling thunder, the lightning growing more vivid and the thunder louder and louder as the storm approaches, a squall of wind coming from the direction of the storm itself, accompanied by a marked fall in temperature, inconstant humidity, large drops of rain, followed by a downpour, often accompanied by hail. Another cycle, covering a considerably longer period of time, is recognized as a precedent of the rains of a barometric depression. Men differ greatly from the lower animals in their sensitiveness to these various stages, and even different individuals, whether in the higher or in the lower orders of animal life, show wide divergence in this respect. As a result, sensitive persons and certain animals feel a coming change because for them the change has already begun, they feel the rising humidity or the changing pressure before others, and they are, in fact, simply changes usually precedent to the larger changes observed by all. However, one or more of these changes may occur without reference to the various other changes, thus explaining why the premonitions are sometimes amiss. But cycles of this nature occur so frequently that traditions of a fair degree of reliability have arisen. It might be added that most of the reliable proverbs based upon the behavior of animals are ultimately concerned with changes of humidity. To such changes certain animals appear to be super-sensitive, while most men are phlegmatic in this respect.

That rain has resulted from the concussions attending the old-fashioned celebration of Independence Day (July 4) or during great battles, particularly those of the Civil War, has long been a popular belief. Even before gunpowder was used for military purposes it was held that rain was produced by the clashing of swords and armor in physical combat. The explanation offered was to the effect that wide-spread concussions caused the small vapor particles floating in the air to coalesce to form raindrops, the dust and smoke furnishing the necessary nuclei of condensation. Records obtained in all parts of the United States and covering long periods of years fail to show that precipitation is heavier or more frequent upon July 4 or 5 than it is upon July 2 or 3. Moreover, so far as the records are available, the rain

accompanying or immediately following great battles is not unlike that which might have been expected in the course of natural events. Bearing in mind the fact, already stated, that throughout large areas rain occurs on an average once in three or four days, and also the subjective fact that rain associated with July 4 celebrations or with battles would doubtless not have been remembered had it not been for such associations, the hypothesis appears to have no foundation. In 1892 the U. S. Government disproved the idea by experiments in which violent explosions of dynamite were produced within clouds by means of kites and balloons, with no rain following as a direct or even as an indirect result. The practise, still followed in various European countries, of attempting to prevent hail by bombarding approaching clouds or of projecting vortex rings of smoke upward, also is without scientific basis. The relatively feeble convectional currents resulting from these artificial attempts to influence the weather are too meager to have any appreciable effect upon the massive convection accompanying storms and are wholly inadequate to influence precipitation.

It is often maintained that cold waves are produced by a descent of cold air from aloft. While it is true that the air aloft is colder than that at the ground, and that up to a height of about six miles there is a more or less uniform decrease of temperature with increase of height, cold waves owe their origin to a number of factors. Nearly all cold waves of the United States occur in the area forming the rear of a passing cyclone and the front of an approaching anticyclone. During the winter half-year this region is characterized by relatively strong northerly or northwesterly winds, clearing skies, decreasing humidity, and the conspicuous fall in temperature. There is a distinct gyratory movement in large disks of air, clockwise, outward from the center, and to a slight extent descending, in the anticyclone, while it is counter-clockwise, inward toward the center, and to some degree ascending in the cyclone. The sharp fall in temperature forming the cold wave is caused primarily by the horizontal transportation of huge masses of cold air from the cold continental interior, and is heightened by the increased radiation from the ground through clear, dry air thus brought in. Vertical currents are probably only of secondary importance in this connection.

In comparing the climates of different places too much stress is generally laid upon mean, and not enough upon extreme conditions of the weather. For example, the average annual temperature, often the only climatological fact quoted in the description of a place, may be very deceptive. Based upon the records of 33 years, the mean annual temperatures of Washington, D. C., and San Francisco, Cal., are practically the same, being 54.7° F. and 54.9° F., respectively. The climates of the two cities are greatly unlike, however. Washington has a semi-continental climate, with daily maximum temperatures in sum-

mer often exceeding 90° F., and minimum temperatures in winter frequently going below 0° F. San Francisco, on the other hand, has a semi-tropical climate, with temperatures of 90° F. or over occurring but two or three times in a year, and minimum temperatures below 40° F. being equally rare. In addition, the climates of the two cities differ greatly in respect to the amount and duration of sunshine, cloudiness, rainfall, relative humidity, wind velocity and direction, and the various other elements which constitute climate. The mean annual temperature is therefore an inadequate indication of climatic conditions, and can not alone serve as a basis of comparison.

Too much emphasis is also placed upon the temperature itself—our feeling of comfort is by no means entirely dependent upon the reading of the dry-bulb thermometer. An ideal curve of comfort might show but little resemblence to the thermograph trace. Relative humidity is so important a contributory factor that the wet-bulb rather than the dry-bulb thermometer is often the better indicator. The feeling produced by a temperature of 100° F. experienced in southern Arizona is wholly unlike that accompanying a similar temperature in an eastern city, the difference being due primarily to the marked difference in relative humidity. Other factors also affect one's feeling of comfort, such as sunshine, wind velocity, barometric pressure, and atmospheric electricity. Some time it may be possible to give correct relative weights to each of these factors in determining their effect upon the man in perfect health. While temperature doubtless will receive the greatest weight, the other factors are by no means negligible.

Night air is occasionally referred to as though it is different from day air, and convalescents are sometimes urged to avoid it as dangerous. While there are obvious physical differences between night air and day air there is little diurnal change in chemical composition. Atmospheric air is a physical mixture which when perfectly dry consists principally of nitrogen, oxygen, argon, and carbon dioxide, in which the relative proportions remain fairly constant, and in which the first two named constitute more than 99 per cent. by volume. Up to heights greater than the summits of the highest mountains the percentage of oxygen, an element necessary in the respiration of both plants and animals, shows no appreciable variation. Carbon dioxide, however, which forms but .03 per cent. by volume, or .05 per cent. by weight, of the air, shows both an annual and a diurnal variation. By volume it is 23 per cent. greater in summer than in winter, and is 12 per cent. greater at night than during the day. Since carbon dioxide does not become dangerous until it constitutes considerably more than 1 per cent. of the air we breathe, the change from day to night can not account for the supposedly offensive feature of night air. Water vapor, which never exceeds 4 per cent. by volume of atmospheric air, is important as far as

respiration is concerned, because of the diurnal change in relative humidity, the change usually being inversely as the temperature. The actual amount present, however, does not change greatly from day to night. If therefore, night air is dangerous for convalescents, and it probably is not, it is because of physical and not chemical differences between it and day air.

The importance of ozone as a constituent of the atmosphere is popularly overestimated, and the numerous advertisements referring to it as the basis of the health-giving qualities of the air at certain resorts are largely a delusion and a snare. In a molecule of ozone, one of the allotropic forms of oxygen, three atoms of oxygen are held together in such a way that there is but feeble chemical attraction of two atoms for the third atom, which readily leaves the other two to form a compound with some other element. It is because of the latter characteristic that ozone has its peculiar properties. Though there is considerable diurnal and annual range in the amount present in the atmosphere, and also a large difference between that of the air in cities and that in the country or in the free air, the relative proportion, in general, is but one part in a million. In nature it may be formed (1) by lightning discharges, thus explaining the unusual odor sometimes perceptible immediately after a thunderstorm, (2) by the evaporation of water, particularly in clouds or near waterfalls and fountains, and (3) the action of ultra-violet light upon oxygen, probably most effective in the free air above the highest cloud level. However, the healthful properties of the air at various resorts is due primarily to the dryness of the air, the relatively low temperature with small diurnal and annual ranges, the absence of dust and smoke, and the increased amount of atmospheric electricity, and only secondarily to the larger amount of ozone present in the atmosphere.

Since the sun is ultimately the source of all the heat of the atmosphere the question is sometimes raised: "Why is not the upper air, being nearer the sun during the day, warmer than the lower air, which is more distant; in other words, why is there not an increase rather than a decrease in temperature with height?" Records obtained by means of kites and balloons show, among other things, (1) that up to a height of about 6 miles there is a more or less uniform decrease of temperature with height, (2) that the density of the atmosphere decreases rapidly with height, it being half as dense at a height of 3.5 miles as it is at sea level, and (3) that the water vapor is limited to the lower strata, 80 per cent. of it being below a height of 3 miles. The last two conditions explain the first. Partly because of the adiabatic rate of decrease of temperature of a gas with a decrease of its density, and partly because of the ability of water vapor to remove and to store

heat energy from the solar rays, the lower atmosphere is warmer than the higher atmosphere.

The source of the water which falls in the form of rain or snow in the United States is erroneously stated in several geographical text-books to be the Pacific Ocean. Such a statement is doubtless based upon the delusion that the United States, located in a region of prevailing west winds, naturally should receive precipitation from the air which has been moving for thousands of miles across the Pacific, and therefore must have accumulated as much moisture as its temperature will allow it to carry. As a matter of fact, by far the greater proportion (one authority says 90 per cent.) of our precipitation has its source in the Gulf of Mexico and in that part of the Atlantic Ocean lying directly east and southeast of the continent. West of the Rocky Mountains the precipitation comes ultimately from the Pacific, but as the rainfall throughout this large area is deficient, except in western Washington and Oregon, the sum total is small compared with that of the nation as a whole. General and widespread precipitation accompanies the passage of a barometric depression, where the winds in its front, blowing from points between northeast and south, discharge a part of their load of water vapor in the form of rain. The condensation is brought about primarily through the cooling air compressing some of its moisture from it, the lowering temperature being caused by a passage of the air from the relatively warm Atlantic or Gulf to the relatively cold continental interior in winter, or from ascending, expanding, and therefore cooling air during summer. Even so large a water surface as that of the Great Lakes contributes but little to the total rainfall of the United States.

Northeast storms, a characteristic feature of the winters of the Middle and the North Atlantic States, do not come from the northeast, as many infer. The strong, northeast, rainbearing winds do, it is true, bring their loads of moisture from the Atlantic Ocean, but they are simply the indraught of a barometric depression which the weather map shows has come from the west or southwest, usually along a well recognized track. Only upon rare occasions does a storm travel from east to west in these latitudes, and storms of this type, called "flarebacks," are still a stumbling-block in weather-forecasting. In general, a storm or barometric depression is accompanied by winds blowing in a counter-clockwise direction and spirally inward toward the center. An examination of the weather map when a northeast storm is in progress will show that the center of the disturbance is southwest or west of the observer, the winds backing to northwest when the center subsequently passes close by or south of the point of observation in its easterly or northeasterly movement.

The tradition that the climate of a city is very different from

that of the surrounding country, while partially true, is often exaggerated in the public mind. According to Professor J. Hann, unquestionably the leading authority on climate, city temperatures differ from those of the open country nearby in the following respects: The mean annual temperature of the air in places where there are many buildings in from 1° to 2° F. too high, the differences being greatest in the morning and evening, and least at noon. The diurnal range is smaller in cities, especially in summer. The cooling by radiation, at night, is much greater in the open than in places which are built up. The cooling due to evaporation probably also plays a part. While it has been calculated that the burning of gas and coal in London develops sufficient heat to have an appreciable effect upon the temperature of the air in a stratum 100 feet thick over that city, no progressive increase in the mean temperatures of New York City and Boston can be found to form a parallel with the growth of those cities. The absolute winter minima are much less marked in the interior of cities than in the surrounding open country. A study of certain cold waves showed that the absolute minimum temperatures recorded in the cities of Toledo, Cleveland, Columbus, and Cincinnati, Ohio, were 20° to 25° F. higher than those noted in the country surrounding these cities. From this the investigator concluded that it would be well to put weather stations near, rather than in, large cities, and at a sufficient distance from them to be free from purely local conditions. It should be added that the temperature felt in the city, under the influence of the radiation from the heated walls of buildings and the reflection from the bare ground, is very different from that felt in the country. Other meteorological elements which show difference between city and country are sunshine, which, on account of smoke, is somewhat less in cities than in the surrounding country, and wind velocity. Every large city has one or more tall buildings about which the wind blows with frequent and violent gusts, even on comparatively calm days. As there is everywhere a rapid increase in wind velocity with height, the taller buildings tend to bring down the higher velocities from aloft. It is thus apparent that there is some degree of difference between the climate of city and country, but when due allowance is made for actual and sensible differences, the effect of the local control upon climate is seen to be small.

Concerning the course followed by a thunderstorm, there are many and varied misconceptions. It is often remarked that a thunderstorm, upon coming to a river valley or a mountain gorge, will divide into two parts, one moving up and the other down the valley, in other words, that thunderstorms tend to follow valleys. Another statement is to the effect that the center or most severe part of the storm passes not over the point of observation, but at some distance away. Instrumental observations fail to verify these and similar generalizations.

From a study of individual storms based upon the records of many stations it has been found that thunderstorms are most frequently formed in the southern half of a cyclone, where warm and light southerly winds are superimposed by cold and heavy northwesterly winds. In the restoration of equilibrium between these horizontal air masses there is violent vertical convection, accompanied by lightning, thunder, heavy rain, and occasionally hail. Though called local storms they usually advance along well defined convex wave-fronts, which measure from 50 to 200 miles in length, moving broadside in an easterly direction across the country, at about the rate of a fast express train. The horizontal breadth of this line varies from 10 to 30 miles, while the vertical convection extends to heights 5 miles or more above the ground. When one considers the vastness of the mass of air in violent agitation in one of these storms it is apparent that the topography of the ground can have no appreciable effect in determining the course of the storm. Certain it is that throughout the central and eastern parts of the United States, where thunderstorms are a characteristic feature of summer weather, the ground relief is insufficient to influence the courses. Nor is there any foundation for the belief that the storm has a center of extreme violence, which is usually stated to have passed a point either north of or south of the observer. When the storm line is passing an observer from west to east, perspective causes the cloud to appear darker to the north and the south, rather than in the front or the rear of the storm, or even overhead.

Tradition has it that "lightning never strikes twice in the same place." The idea is not only without scientific basis, but the opposite may be nearer the truth, for if the conditions which attracted a lightning discharge are not disturbed by such a discharge there is great probability that they may attract the lightning a second time. In general, any good electrical conductor projecting above material which offers resistance to the passage of electricity will tend to attract lightning. If this projecting conductor is insulated from surrounding material and is anchored deep in the soil, down in the level of permanent moisture, the conductor will protect the surrounding objects. This is the theory of the lightning-rod, which, when properly installed, is a good protector. Though it does actually attract the lightning it may be struck any number of times without damage to things nearby. The Eiffel Tower, in Paris, France, a steel tower 1,000 feet high, has often been struck, six times during the passage of one particularly severe storm. As ample provision is made to conduct the electricity to the earth no serious destruction has resulted. The tradition "lightning never strikes twice in the same place" is therefore more nearly correct when the word never is omitted.

That freezing temperatures are necessary for the formation of hail

has sometimes led people to conclude that the hailstones must have necessarily come from the far north, falling as they do on days when the heat has been oppressive. True hailstones occur only with storms of the thunderstorm type, where violent convection extends to heights of five miles or more above the ground. Here the ascending currents are occasionally so strong that they carry aloft, far beyond the level of permanent freezing temperature, particles of moisture already condensed into raindrops. In the average, there is a fall of temperature of 1° F. for every 300 feet of height, so that even in midsummer, when the temperature at the ground is 90° F., one has to ascend but $3\frac{1}{2}$ miles to encounter a freezing temperature. The water droplets, solidifying upon entering the freezing stratum of air, later fall to lower levels, where they may again be caught up by ascending currents to the colder strata above. This process may be repeated a number of times, with the result that the hailstones, upon finally reaching the ground, will show concentric layers of ice and snow. The moisture content more probably came from the Atlantic Ocean, to the east, or the Gulf of Mexico, to the south, rather than from the far north.

The development of meteorology and climatology has been so recent that the general public has not kept pace with the progress. While there are thousands of weather proverbs which are correct generalizations of weather observations extending over many years, a number of traditions have persisted which are apparently without scientific foundation. A few of these, originating in European countries, and doubtless true in their native environment, have proved inapplicable when imported to America. Others are inadequate as they make no distinction between the real and the apparent—between the objective and the subjective. Still others are found wanting because they are based upon fallacious ideas. Instrumental observations, laboratory experiments, and the exploration of the free air have exposed many more misconceptions. Though we have made but a small beginning in a systematic science of the weather, we have advanced far enough to make it possible to eliminate some of the earlier preconceived notions.

DUCTLESS GLANDS, INTERNAL SECRETIONS AND HORMONIC EQUILIBRIUM. III

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IV

THE most remarkable fact about the internal secretions is that they are correlated with one another. Not only has this been abundantly demonstrated by experiment, but, in many cases, pathological lesions of the individual glands cause some disturbance in the functional relations of the other glands—the so-called "pluriglandular syndromes." The idea of a correlative relation is not necessarily new, was perhaps implicit even in Bordeu's statement of the theory, but it did not begin to acquire tangible and intelligible form until the complex chemistry of the metabolism of the body had beeen better understood. On the physiological side, it has been noted, for instance, that excision of the pancreas produces glycosuria, even after thyroidectomy and parathyroidectomy, but not after excision of the adrenal bodies; that partial excision of the thyroid in bitches will produce a mild myxœdema, if pregnancy supervenes, the symptoms disappearing after littering; that the thymus gland is often enlarged in exophthalmic goiter but will atrophy after thyroidectomy; that castration is followed by enlargement of the thymus, and, conversely, excision of the thymus produces swelling of the ovaries. On the pathological side, the thyroid is often enlarged during puberty, menstruation, excessive venery (*e. g.*, in prostitutes) and pregnancy; swelling of the ovary and menstrual disturbances often accompany goiter. Myxœdema often comes on at the menopause or in connection with sterility. Acromegaly, as was shown by Edwin Klebs, is often accompanied by enlargement of the thymus. Enlargement of the pituitary often accompanies pregnancy or hibernation, yet castration causes enlargement of the pituitary in the young and acromegaly is often associated with loss of sexual power. The fact that many of these experimental results and pathological findings do not harmonize makes the problem one of extreme complexity. Furthermore, it is known that lesions of different ductless glands will produce isolated identical effects, which overlap each other in a group of symptoms, making the causal relation dubious when there is a "pluriglandular syndrome." Glycosuria (lowered tolerance for carbohydrates) may be produced by goiter, by injection of thyroid extract in acromegaly or by injection of pituitary extract, by excision of the parathyroid body, by

injection of adrenalin, by excision of the pancreas or by a lesion of the islands of Langerhans in that organ. On the other hand, an increased tolerance for carbohydrates (obesity) occurs after destruction of the posterior lobe of the pituitary body, as well as in myxœdema or after thyroidectomy; increased blood pressure follows upon injection of the pituitary, adrenal, placental and kidney extracts; lactation is accelerated by injection of extracts of the thymus, pineal and pituitary bodies and the corpus luteum (ovary); the pupil is dilated by extracts of the thymus, pituitary, pancreas, suprarenals, kidney, sexual glands, liver and muscle. Effects of this kind are analogous to the mystifying "enharmonic cross relations" in modern music, in which the same note (on the piano scale) is so employed that it is brought into relation with two different tonalities. C sharp and D flat, G sharp and A flat produce the same sounds when given on the piano scale, although they can, if necessary, be distinguished on stringed instruments, which render an exact account of the difference in the number of vibrations. Similarly, these apparently identical effects of the different ductless glands indicate that their functions are correlated, that they are somehow concerned in maintaining the hormonic equilibrium of the body.

Concerning the mechanism of correlation, two prominent theories have been advanced. The first is the doctrine of the hormones of Bayliss and Starling (1902) in which the chemical control of the body is assumed to be effected by means of hormones, or chemical messengers, which pass from the various organs and ductless glands, *via* the blood-stream, to other parts of the body, producing biochemical effects upon irritable protoplasmic tissues. In the initial experiment of Bayliss and Starling, the secretion of pancreatic juice following upon introduction of acid into the duodenum was found to be not a local reflex, as had hitherto been assumed, but due to the action of a hypothetical substance (secretin) discharged by the intestinal mucous membrane under the influence of the acid and carried to the pancreas by the blood channel. Many experiments, particularly those of Howell on the coagulants and anticoagulants of the blood (thromboplastin and antithrombin) indicate the existence of hormones. Adrenalin, iodothyrin and pituitrin are the only hormones of the ductless glands which have been isolated to date.

The other theory is that of the clinicians and pharmacologists of the Vienna school, Eppinger, Falta and Rudinger, which asserts that the suprarenal and thyroid bodies act upon and are controlled by the nerves of the sympathetic system, while the pancreas is similarly related to all nerves acting upon smooth (involuntary) muscle and not originating from the chain of sympathetic ganglia. The two systems have been termed "autonomic," because they seem to be detached from and independent of the controlling impulses arising from the cerebro-

spinal axis, while themselves controlling all organs containing unstriped muscle, secreting glands or both, *e. g.*, the smooth muscle of the bronchi, stomach, intestines, blood vessels, genitalia, eye and all the glands of external and internal secretion. The sympathetic or visceral nervous system has also been called the "vegetative" system, because the organs under its dominion functionate involuntarily or unconsciously, as with vegetables or plants. At present, the term "vegetative system," formerly termed the autonomic system by Langley, is restricted to that part of it which originates from the sympathetic ganglia, while the antagonistic system governing involuntary muscle, which is largely made up of fibers from the vagus nerve, is now styled the "vagal autonomic."

The difference between the two autonomic nervous systems and the central (cerebro-spinal) system is that, in the former, the nerve fibers never proceed, as ordinarily, directly from the nerve center to the organ controlled, but pass, as neurons, from the gray substance to a ganglion in which they encounter a break or synapse (separating surface), on the other side of which a similar post-ganglionic neuron proceeds to the organ controlled. The synapse, a term first proposed by Sir Michael Foster, has been likened to a switch over which the nervous impulse jumps to proceed on its way. Langley, the original investigator of the autonomic systems, discovered that wherever there is a switching of the nervous impulse across a synapse; the effect can be abolished in other words the post-ganglionic fiber can be paralyzed, by painting over the exposed ganglion with nicotine solution, thus determining whether an autonomic nerve fiber passes through a ganglion without interruption or not. If, after painting the exposed ganglion with diluted 0.5 nicotine solution, or even after internal administration of the alkaloid, the effect of central excitation of the post-ganglionic fiber at the ganglion is the same as ordinarily, then there is no interruption; but if the effect is abolished under these conditions, then the pre-ganglionic fiber terminates in a synapse. Langley's nicotine effect holds good for all ganglia of the autonomic systems, whether of sympathetic or vagal origin. In other respects, however, these two systems are antagonistic, both in respect of physiological functions and response to the action of drugs. The effect of electrical stimulation of a sympathetic fiber is just the opposite of that of a vagal autonomic fiber. The sympathetic fibers check, the vagal autonomic fibers excite, the movements of the intestines; the sympathetic dilates, the vagal autonomic contracts, the pupil; the sympathetic hastens, the vagal autonomic slows, the heart. Adrenalin (epinephrin), which the Viennese clinicians assume to be the specific hormone of the sympathetic autonomic, produces, on ingestion or injection, effects similar to those produced by electrical

stimulation of the sympathetic, viz., dilatation of the pupil, dry mouth from diminished salivary secretion, rapid heart action, glycosuria and increased secretion and motility of the stomach and intestines. Hence adrenalin, and drugs, like ergotoxin, which resemble it in action, are variously termed sympathicotropic, sympathicotonic or sympathicomimetic. On the other hand, certain drugs, such as pilocarpin, muscarin, physostigmin, cholin and digitalis, which stimulate the autonomic fibers of the vagus, producing effects diametrically opposite (contraction of the pupils, profuse salivation, slow heart action, pollakiuria, etc.) are termed vagotropic, vagotonic or vagomimetic, because their action simulates the vagal autonomic. Thus the Viennese clinicians postulate two opposing diathetic conditions, sympathicotonus and vagotonus, the symptomatology of which can be thrown into relief by certain pharmacodynamic tests, which have been likened by Januschke to "tuning keys by means of which we can operate upon the complicated stringed instruments of the body, and voluntarily make one string tighter to increase its vibration or another looser to dampen its function."[25] To complete the analogy of their tripod of ductless gland correlations, Eppinger and Hess assume that the pancreas, controlled by the vagal autonomics, secretes a hormone "autonomin," which is supposed to antagonize adrenalin, the hormone of the sympathetic system proper. So far, this is a very cogent and fascinating theory, but, as often happens, it does not work out according to specifications in all cases, and is strongly opposed by Gleg. The symptomatology in vagotonic and sympathicotonic patients, too complex to be considered here, is extremely variable and the reaction to drugs sometimes unreliable. Thus, Eppinger and Hess themselves found that pilocarpin and adrenalin sometimes produce strong reactions in the same patient. The interest of their theory for present purposes lies in its capacity for elucidating the action of the ductless glands and internal secretion, for behind the ductless glands and the hormones themselves there must be some controlling mechanism. It is assumed that when the vegetative and vagal autonomics are over-excited (sympathicotonia, vagotonia), these act upon the viscera and the ductless glands, the hormones or internal secretions of which in turn react with redoubled force *via* the blood channels upon the autonomic nerve centers, vegetative and vagal, producing a vicious circle, as Hemmeter maintains.[26] Thus the hormones of the viscera and the internal secretions of the ductless glands regulate the tonus of the nervous system, while the autonomic nerve fibers themselves regulate the action of the ductless glands, the viscera, blood vessels and all organs containing involuntary muscle.

25 Cited by Barker.

26 J. C. Hemmeter, *New York Med. Jour.*, 1914, XCIX., 108.

The importance of the subject in relation to clinical medicine has been well emphasized by Professor L. F. Barker.[27]

In how far those sudden and violent excitations of the autonomic nervous system which accompany strong emotions are due to the intervention of the glands of internal secretion, and in how far they depend upon direct neural conduction from the brain, we are as yet but ill-informed. I need only remind you of the vasodilatation of the face in the blush of shame, of the stimulation of the lacrimal glands which yields the tears of sorrow, of the palpitation of the heart in joy, of the stimulation of the sudoriparous glands which precedes the sweat of anxiety, of the stimulation of the vaso-constrictors, the pupil dilators and the pilomotors in the pallor, mydriasis and goose-skin of fright, to illustrate some of these violent autonomic excitations. While we do not yet understand the exact mechanisms of association among the activities of the cerebrum, the endocrine glands and the reciprocally antagonistic autonomic domains and their end-organs, we can begin to see the paths which must be followed in order that more exact knowledge may be gained.

The balance maintained normally between the two antagonistic systems is one of the most interesting of physiological phenomena. Think, for example, of the rate of the heart beat—how constantly it is maintained at a given level in each individual when the body is at rest; the impulses arriving through the vagal system just balance those arriving through the sympathetic system, so as to maintain a rate of approximately seventy-two beats per minute. And a similar balance is maintained in other autonomic domains (*e. g.*, pupils, bronchial musculature, gastric glands, gastro-intestinal muscle, sweat glands, bladder muscle, etc.).

This equilibrium is all the more remarkable when one considers how frequently it is temporarily upset in the exercise of physiological function. The play of the pupils with varying light, the watering of the mouth at the smell of savory food, the response of the heart to exercise and emotion, the flow of gastric juice on adequate stimulation, the opening of the bile duct at the call of the chyme, the transport of the colonic contents through one third of the length of the colon through one vehement contraction every eight hours, the sudden relaxation of the sphincter and contraction of the detrusor of the bladder in micturition, the violence of contractions in the domain of the N. pelvicus in parturition in the female and in the ejaculation in the male, come to mind at once as examples of sudden physiological overthrow of balance.

Another set of correlations advanced by the Vienna school is connected with the causation of diabetes. Eppinger, Falta and Rudinger regard the thyroid, pituitary and adrenals (chromaffinic system) as the accelerators or mobilizers of glycosuria, in that all three increase exchange or metabolism of proteins, the adrenals mobilizing carbohydrates and the thyroid increasing fat absorption. The pancreas and the parathyroids, on the other hand, are held to be inhibitors of glycosuria, retarding protein metabolism and restricting the mobilization of carbohydrates. Diabetes following excision of the pancreas is held to be due to the mobilizing power of the adrenal hormone on the

[27] L. F. Barker, *Canadian Med. Assoc. Jour.*, Montreal, 1913, III. See, also, W. B. Cannon, "The Interrelations of Emotions as Suggested by Recent Physiological Researches," *Am. Jour. Psychol.*, Worcester, Mass., 1914, XXV., 256–282.

glycogen of the liver, the normal inhibitory action of the pancreatic hormone being removed, and is thus at once a positive adrenal diabetes and a negative pancreatic diabetes. This harmonizes with the glycosurias following injection of adrenalin or following increase of the adrenal function from stimulation of the sympathetic system. Hyperthyroidism (exophthalmic goiter) produces a tendency to glycosuria from relative pancreatic insufficiency and increased adrenal activity. Myxœdema or the corresponding removal of the thyroid gland produces an increased tolerance for carbohydrates (obesity) because the inhibitory function of the pancreas is removed and adrenal action diminished. There is a lowering of carbohydrate tolerance after parathyroidectomy. The lowered carbohydrate tolerance in hyperpituitarism and the increased tolerance in hypopituitarism, demonstrated by Cushing, is explained by the inhibitory action of the secretion of the posterior lobe of the pituitary on the pancreatic hormone, mobilization of glycogen and glycosuria resulting when the pituitary secretion is in excess and the restraining influence of the pancreas thus impaired. Cushing and Jacobson found that the obesity or high sugar tolerance following excision of the posterior lobe of the pituitary will persist even after subsequent excision of the pancreas, no glycosuria developing.

The question arises, how do the internal secretions or hormones act upon the central nervous system? Here we encounter what Ehrlich calls that obscure province of physiology, the specific irritability of organized tissues, or the capacity of protoplasm to react to chemical and other stimuli. If a chemical substance in the blood comes in contact with the chemoreceptors or special groups of atoms in the periphery of a cell, the two sets of substances may remain inert in relation to each other, they may combine, producing equilibrium, or they may induce a vigorous reaction through difference in their chemical potentialities. The complexity of this phase of the subject is fairly indicated in Abderhalden's studies of intracellular metabolism, in which he shows that by linkage of three different amino acids, *A, B, C,* the following isomeric arrangements can be produced by permutation and combination, viz.,

A-B-C *A-C-B* *B-A-C* *B-C-A* *C-A-B* *C-B-A.*

In like manner, from linkage of four amino acids, 24 structurally isomeric compounds may result, from five, 120; from six, 720; from seven, 5,040; from fifteen, 1,307,674,368,000; from twenty, 2,432,902,008,176,640,000. We have as yet no calculus of variations fine enough to estimate even the rate of change of these evanescent combinations, which we may assume. are constantly taking place within the cell.

Again, it may be asked, is the hormonic equilibrium of the body identical with thermodynamic equilibrium? And here we have another problem which may be described as transcendental. In the ordinary

metabolism of the body, it is agreed that the first law of thermodynamics—conservation of energy or constancy of the sum of energy in an isolated system—applies in every respect. Does the second law—irreversible dissipation of energy in one direction—apply to such relatively isolated (adiabatic) systems as a cell enclosed in its cell-wall or the animal body encased in its integument. Does the cell or the organism act like a heat engine or an electric cell, dissipating its energy in one direction, or is it a reversible mechanism, like a dynamo. In the animal body, the food stuffs of high chemical potential, proteids, carbohydrates and fats, are degraded and transformed into substances of low chemical potential (carbon dioxide, urea and water), the energies passing, as in a Carnot cycle, from a source of high potential to a sink at low potential energy. The second law is operative here, but the process is more economical than in a heat engine. Still more economical is it in cold-blooded animals, while in green plants there seems to be an actual reversal of the process, in that substances of low chemical potential (nitrogen compounds, carbon dioxide and water) are transformed into substances of such high chemical potentiality as carbohydrates, proteids and oils. There is thus some indication that in plant cells, or those organisms, like bacteria, which lie between animals and plants, there is a possibility of reversal of those physical processes which take place in inanimate nature. Of this we have further examples in the nitrification of the soils by bacteria buried in it (without the aid of radiant energy from the sun) or in the Brownian movements of bacteria contained in a liquid.[28] Of the possibility of reversing the second law in the human organism Lord Kelvin said that "even to think of it, we must imagine men with conscious knowledge of the future, but no memory of the past, growing backwards and becoming again unborn, and plants growing downwards into the seeds from which they sprang." This would assuredly be an extreme case, but Cushing's production of sexual infantilism in dogs by partial excision of the anterior lobe of the pituitary body fulfils some of these conditions. At best, we can only affirm that the whole matter is transcendental, that is, so far beyond our ken, since it involves an assumption of the old metaphysical "vital principle," which Bergson revamps as the *élan vital.*

A very complex view of the internal secretions and hormones is that which connects them with the general protective mechanism of the body. The earliest to advance this view was Dr. Charles E. de M. Sajous, of Philadelphia, whose treatise on the internal secretions, published in 1903, has passed through six editions, and has undoubtedly played a prominent part in bringing the subject to a focus in this country. In relation to immunity, Sajous's main position is that the

[28] See J. Johnstone, Proc. and Tr. Liverpool Biol. Soc., 1913, XXVII., 1–34.

germicidal and antitoxic substances in the body are originally derived from certain ductless glands, the immunizing mechanism in question comprising the "adrenal system" (adrenals, pituitary and thyroid). He holds that the adrenal secretion mobilizes zymogens in the body, endowing them with their ferment-activities, that secretin is "adrenoxidase," that enterokinase is adrenoxidase plus nucleo-proteid, that the pituitary body has no internal secretions, but is the general and governing center of the sympathetic system and of all vegetative functions, that, as an immunizing center, it is the homologue of the "test organ" of mollusks and other invertebrate animals, and that the body at large is protected from disease by an "auto-antitoxin" composed of the internal secretions of the adrenal (adrenoxidase; Ehrlich's amboceptor), of the pancreas (trypsin; Ehrlich's complement), of the spleen and leucocytes (nucleoproteid), and of the thyroid and parathyroids (thyroiodase; Wright's opsonins). Upon this theoretical substructure, which was arrived at by deductions based upon clinical and experimental data, including some of his own, the work of a mind of mathematical cast, Sajous has erected a complete system of medicine, connecting his ideas with all known diseases and their treatment.[29]

Without presuming to discuss the merits of these different views, it may be said that their very complexity indicates that present knowledge is in a state of flux and that only the surface of the subject has been scratched so far. We can not object that "facts not opinions" are wanted here, for the collective mass of observations and experiments is enormous. But all recent investigations, those of Abderhalden on the protective ferments of the body, for instance, indicate a general reaching out for a larger correlation or synthesis, which shall weld so many seemingly contradictory observations into a harmonious whole. In 1912[30] von Behring included as "agents of infection," pathogenic microorganisms and their toxic products and the poisons produced by animals (venoms, etc.) and the higher plants (abrin, ricin, ergotin, etc.), and it would seem even reasonable to include in this group certain mineral poisons like arsenic or lead, the action of which mimics an infectious disease. In February, 1914[31] von Behring made another generalization of equal sweep, in which he brings such concepts as idiosyncrasy, susceptibility to disease, diathesis, anaphylaxis and supersensitiveness to toxins into one and the same category. The Viennese clinicians associate diathesis with the ductless glands. Sajous associates the ductless glands with immunity from disease. This is all that can be affirmed of present theories of the subject.

[29] Sajous has given a recent presentation of his views in *American Medicine*, Burlington, N. Y., 1914, XX., 199–210.

[30] E. von Behring, ''Einführung in die Lehre von der Bekämpfung der Infektionskrankheiten,'' Berlin, 1912.

[31] *Schmidt's Jahrb.*, Bonn, CCCXIX., 113–124.

Perhaps the most interesting feature of the ductless glands is their correlation with the sexual function. It is plain that, except as generic types, these categories have no special application to normal humanity. The dunce's cap is surely ready for him who confuses physiological tendency with individual morality, in each case an artificial inhibition put upon reaction to stimuli. Aside from the other correlations, diminished sexual power is common to the two main groups of pituitary disorders, acromegaly and sexual obesity or infantilism. The acromegalics have been likened to the Neanderthal man, who was probably, as the gorillas are, hyperpituitary (Keith), to eunuchs, who are excessively tall when not over-corpulent, and to the tall, raw-boned, heavy-jawed peoples of the northern countries who are often sexually cold. The obese infantile patients of the Fröhlich type, on the other hand, suggest the fat boys of the Pickwick Papers and the large hotels, and the eunuchoid "Lobengulas" described by Sir Jonathan Hutchinson.[32] Even in folk-lore, obesity always connotes sexual frigidity.[33] In a recent view of Dr. Leonard Guthrie, the autopsy of the great Napoleon at St. Helena indicates that the corpulence of his later years, his gradual loss of intellectual keenness, his general fat-headedness from the time of the Russian Campaign, may have been due to the onset of a pituitary obesity, the dystrophia adiposo-genitalis of Mohr and Fröhlich.[34] The logical opposite of the acromegalics are therefore, not the fat patients of the Mohr-Fröhlich type, but the short, swarthy, goat-legged achondroplasics who often exhibit great muscular strength, unusual sexual precocity and general salacity. These have been assimilated to the satyrs of mythology to the short, swarthy, troglodyte peoples such as the Iberians, or the Euskarians, the primitive inhabitants of Britain, to "the short-limbed children, of precocious sexuality," and particularly the "forward female children, with full busts, already boasting of their affairs,"[35] who are so common on the streets of modern cities. It was not without reason that the Greeks represented the great god Pan as a goatish individual. Except in the negro the generic sexual type, the differential characters of which are harped upon even in the plays of Dumas *fils*, is short, swarthy, muscular; the frigid type, of high pituitary index, is either flabby and obese (the *kühle Blonde* of the Germans) or the lank, raw-boned acromegalic. It is said that many achondroplasic dwarfs of history, like Sir Geoffrey Hudson, were of the salacious type. The records of the obstetric clinics show that female achondroplasics, married or unmarried, have sometimes undergone the operation of Cæsarean section three or four times run-

32 See, *Univ. Med. Record*, London, 1912, I., 119–121.

33 "*Ein gutar Hahn wird pelten fett,*" etc.

34 F. Guthrie, Proc. XVII. Internat. Cong. Med., 1913; London, 1914, Sect. XXIII., 143–154.

35 *Univ. Med. Record*, London, 1912, I., 121.

ning. The amazing fertility of achondroplasic women has been emphasized in the statistical or biometrical investigations of Karl Pearson, and that this type connotes extreme sexuality is borne out by the observations of Pierre Marie and his co-workers at the Salpêtrière. Crookshank maintains that "the Bengalee is pretty much in the same state as a sufferer from a *forma frusta* of exophthalmic goitre; while the pigmentation and genital gigantism of the negro are suggestive of adrenal assertion." He further points out that "certain genital malformations or abnormities are almost always accompanied by adrenal tumors; and Iscovesco has shown that adrenal lipoids when administered hypodermically rapidly produce genital overgrowth."[36] On very slender evidence, achondroplasia has been correlated by some observers with disease of the pineal body (epiphysis cerebri), which Descartes regarded as the seat of the soul. Disease of the pineal in young children sometimes results in increased development of the sexual organs with corresponding growth and mental precocity, whence it is inferred that the pineal secretion inhibits growth, particularly the development of the reproductive glands.

Of the internal secretions of the pancreas and the sexual glands, the thyroid, parathyroid, suprarenal and pituitary bodies, considerable is known; less of the spleen, carotid gland and pineal body (epiphysis cerebri); of the "parathymoid" and the paraphysis of the brain, nothing whatever. The vast amount of recent investigation on the subject has been well summed up in the treatises of Sajous (1903), Arthur Biedl (1910), Swale Vincent (1912) and Wilhelm Falta (1913) on the internal secretions, and such individual monographs as those of Friedleben on the thymus (1858), von Eiselsberg on the thyroid (1901) and Cushing on the pituitary (191–). All these are liberally provided with bibliographies, Cushing's book being a model in this respect, and Cushing and Falta give splendid illustrations. Cushing's work, which a competent critic has pronounced to be the most important American monograph on a surgical subject printed in the last ten years, is also a genuine contribution to internal medicine. With John Hunter the surgeon began to be, not only an experimental physiologist and pathologist, but also a clinical observer. Modern medicine affords many examples of original descriptions of new diseases by surgeons, in particular, Sir James Paget and Sir Jonathan Hutchinson, whose "Archives of Surgery," twelve volumes entirely written by himself, is a great storehouse of unique pathological observations. Professor Cushing's work is in this class, the subject is approached from the physiological, pathological, clinical, surgical and ophthalmological sides, and in its combination of induction from experiment with the Hippocratic induction from experience, it is a fine exemplar of what Sir Michael

[36] Crookshank, "School Hygiene," London, 1914, V., 71–72.

Foster regarded as the ideal method of investigation in internal medicine:[37]

Each case of illness is to the doctor in charge a scientific problem to be solved by scientific methods; this is seen more and more clearly, and acknowledged more and more distinctly year by year. Nor is it true that each science has to a certain extent its own methods, to be learnt only in that science itself; and from time to time we may see how a man eminent in one branch of science goes astray when he puts forward solutions of problems in another branch, to the special methods of which he is a stranger. In nothing is this more true than in an applied science like that of medicine. At the bedside only can the methods of clinical inquiry be really learnt; it is only here that a student can gain that kind of mind which leads him straight to the heart of disease, that *genius artis*, without which scientific knowledge, however varied, however accurate, becomes nothing more than a useless burden or a dangerous snare. Yet it is no less true that the mind which has been already sharpened by the methods of one science takes a keener edge, and that more quickly, when it is put on the whetstone of another science, than does a mind which knows nothing of that science. And, more than once, inquiry in one science has been quickened by the inroad of a mind coming fresh from the methods of a quite different science. For all sciences are cognate, their methods though different are allied, and certain attitudes of mind are common to them all. In respect to nothing is this more true than in respect to the methods of medicine. Our profession has been the mother of most of the sciences, and her children are ever coming back to help her. In our art, all the sciences seem to converge—physical, chemical, biological methods join hands to form the complete clinical method.

[37] Foster, Huxley Lecture, *Nature,* London, 1896, LIV., 580.

THE ETHICAL PRINCIPLE IN PHYSICAL VALUATION FOR RATE MAKING

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THE history of the control of public service corporations in this country is very short, but its interest is great enough to warrant even now a historical monograph of considerable length. Though the movement toward governmental control is new, it has been rapid. It culminated about a year ago in the passage of a law authorizing the Interstate Commerce Commission to make a valuation of railroads under its jurisdiction. Physical valuations have been provided for in Wisconsin, Nebraska, Washington, Massachusetts and other states. In general, the state valuation laws, as, for instance, that in Nebraska, provide for the valuation of practically all public service corporations. When we consider the history of corporations in the United States, the adoption of this policy with a view to control of public utilities appears logical enough, and opens a new field of discussion. Some parts of our railroads are eighty years old. Many were built under unusual conditions. The early days of many public service corporations display a tangle of promotion, corruption, lease, combination, purchase and reorganization. Original records in many cases are lost. As a result, the discussion of physical valuation has been largely confined to consideration of the ultimate, technical details of some practicable method, to the neglect of important underlying principles. Valuation has been usually argued from the point of view of the material interests of the disputants. It has been only within the past two or three years that really serious conclusions have been arrived at; and the discussion since the passage of the Physical Valuation Act affecting the Interstate Commerce Commission has alone provided some basis for a formulated set of principles around which interest now centers. A small vocabulary of technical terms has developed in the course of the debate as to principles and methods.

There is an aspect of valuation that has not received the emphasis it deserves. A study of the economic and social phases of the subject may be made much more illuminating than it has been. It appears that such a study would provide a solvent for several of the problems now in dispute among writers of undoubted ability and experience. In the first place, the public attention has not been directed toward corporation control because it had nothing else to busy itself with. The movement toward physical valuation is not an erratic one. The public's point of

view has of late years been changing. People are seeing that they have an interest in public service corporations different from that concerned merely with securing good gas, steady current, accommodating trolley service, or pure water. The new laws providing for physical valuation as a basis for determining rates for the use of public utility products or services are an evidence of this change of attitude.

That the public, the user, has been slow to recognize his real interest in public service corporations does not in the least lessen the rightfulness of that interest, or its substantial basis in fact. A savage has little or no ethical life; for although an ethical principle may be absolute *per se,* the strength of that principle applied depends on contributory circumstances of a nature to compel its recognition. Circumstances of corporation growth, the misuse of the power flowing from privileges granted to individuals by public official bodies, have at last forced the user of the public utilities to recognize his ethical right to consideration.

The interest of the user in the public service company is, of course, first of all, material. The company furnishes some service necessary to health or to the reasonable comforts of modern life, or something necessary to business. These services can not generally be secured except from the public service corporation. For this reason the corporation is looked upon rightly enough as a quasi-public organization. It is no longer a private affair. It is not like the corner grocer or apothecary, who has a competitor on the next corner to whom the customers can go. It is not like the butcher, who has his stall in the public market in a row of twenty similar stalls, and who competes for trade among the passing throng. The public service corporation has, in great degree, the character of a monopoly. The quasi-public element in the public service corporation is recognized originally and conclusively by the grant of any franchise carrying special privileges or providing for exclusion of other similar corporations.

In addition to this material interest, arising in the need of the community for fresh and pure water, light, heat and transportation, there is the other, deeper consideration spoken of above. This flows from the material interest, and is best described as an ethical interest. It is not merely by equity or expediency that the user has rights in public service utilities. It is because he puts something into the business. What he puts in is fixed capital; he can not withdraw it, and heretofore has had little or nothing to say regarding the management of his share of the investment. Much of this fixed capital, owned by the user of the public service utilities, is in the form of franchise privileges granted by the user, through his representatives in the local legislative body, for a period of years or in perpetuity. It is just as surely a vested interest as the money of the bond holder which has laid rails or strung wires, dug ditches or erected pumping stations and gasometers. The fact that the

consumer turns the management of his interest in the business over to the other party, together with the fact that when once these contributions are made they can not practicably be withdrawn, establishes the right of the user to fair treatment at the hands of the public utility company. Still stronger appears the user's right to fair treatment when it is considered that he is, in the very nature of the case, the residual investor. That is, under any plan to establish such rates as will provide a "fair return" to the money investor, the user must hold himself ready at any time to meet all demands for financial support involved in the operations of the utility. The user may not provide additional money capital in the early years of development, and may never indeed do so. But if such becomes necessary, the user must, as will be seen, assume the burden of interest charges created by the required borrowing. Mutual obligations between the user and the producer follow naturally as a result of mutual interests. These obligations are as binding on one as on the other. Responsibility for fair treatment has in the past rested with the producer exclusively, because he has occupied the position of control. Unfortunately, the user has not been convinced by the treatment that he has received that his rights have had the recognition they are entitled to. The present movement has resulted, and the relative obligations of both parties are now very generally understood. The investor and producer must be secured in an adequate, "fair return" on his investment. The investment does not necessarily include all the money spent in creating the utility. It is no part of the user's duty to secure to the investor a return on funds spent unwisely, unnecessarily or in any improper way. For instance, construction work might have been done and paid for at an exorbitant rate. It later might develop that the officials in charge of construction were materially interested in the contract and had paid for work at unwarrantable prices because it was to their own advantage to do so. This is the simplest case. More involved ones have not infrequently occurred having essentially the same result. Such expenditures are not wise or necessary by any means, and the user is not bound to recognize them as a part of the investment on which the producer is entitled to a "fair return."

The chief right of the user is to receive efficient service at a rate as low as possible consistent with the right of the investor to receive his "fair return." It is the obligation of the producer to see that this service is provided at a "fair rate" consistent with the conditions under which the public utility is expected to operate. It is the consciousness of these mutual obligations that is the basis of laws restraining public service corporations. The user has seen his investment exploited for the benefit, not of himself, but of the producer. The capitalization of anticipated profits, stock dividends, unduly large underwriting fees in effecting combinations, common "watering" of stock, manipulating and

speculating in the securities of public service companies, have all operated in most cases to the disadvantage of the user, the co-investor in the concern. Legal relief has been the obvious remedy sought, and if it has seemed arbitrary, such a condition is only natural as a kind of reaction against the formerly very loose check set upon the conduct of the producer.

It is generally agreed now that a common ground of adjustment has been reached, and that by making a physical valuation of the property of the producer, it will be possible to fix the "fair rate" that is consistent with a "fair return" to the producer under the conditions of operation required of the public utility under consideration.

The details of physical valuation are involved and numerous. Much discussion has taken place, and it continues from week to week in the press and in the courts. Very excellent authorities are at difference with each other on essential points. The difficulty appears to reside in the fact that a common basis in principle cognizant of the interests of the public and of the producer can not be found by those attempting to establish the methods of physical valuation. The first point that must be understood is that a public utility property shall no longer be speculative in character. This is the obvious result of the recognized obligation on the part of the public—the user—to assure the producer a "fair return" on his investment.

The returns on the public service utility investment are, under the plan proposed, to be made fair and equitable by establishing such a rate for the service that the "fair return" will be reasonably assured. This removes the utilities stock from the speculative class. Further, if there remains a speculative element in the utilities stock, it would be an indication of necessary readjustment of "fair rates" to "fair returns."

We are now ready to consider some large details of a physical valuation which are illumined by the principle outlined above; namely, that the user has a right in the properties of the public service utilities; that this right rests on the investment of certain valuable contributions necessary to the operation of the utilities; that flowing from these rights is an obligation that the investor shall be assured a "fair return" on his investment.

If records were complete, the ideal method of arriving at the investment of the investor of funds would be at hand. In some cases it will doubtless be found that such records are complete. Where they are not, the obvious course is to reproduce the actual conditions under which construction was advanced, and estimate the original cost of the properties. There is little difference of opinion that cost of surveys, preliminary studies and investigations, and underwriting and promotion charges which are wise, necessary and reasonable, should be allowed. What shall determine reasonableness in this case is open to debate, but we have

some checks. We know that the ordinary commission on stock transactions is one eighth of one per cent. Six per cent. is considered a fair return on investments free from unusual risk. Here, then, are upper and lower limits that may be considered reasonable for underwriting and promoting. The excessive commissions occasionally taken in promoting industrials are certainly unwarranted and should no longer be allowed. In valuating past performances of this kind, and allowing for due risks in the original scheme, it is doubtful if a greater promotion charge should be recognized than would be just and fair to-day. The fairness of this will further appear when we consider deficits and their place in valuation for rate-making purposes.

There is little or no dispute over the valuation of large single elements of the properties until we come to land. Here we meet the first troublesome detail of the subject. The question of land values has puzzled almost every commission to whom has been assigned the physical valuation of utilities. The chief point in dispute is the place of unearned increment. There is no doubt that the actual cost to the company of the land that had to be taken should be allowed. If the cost is a matter of record, it should be taken. This cost should include the necessary severance, damage, transfer and legal charges connected with taking the land. In most cases the records do not exist, and an approximation is resorted to involving the use of a factor to be applied to the present market price of adjacent land. In any case, however, the principle to be followed prescribes that the actual net cost of acquiring the land at the time it was purchased shall be approximated as nearly as may be. To this nothing should be added to represent the increased value since acquisition. This statement is most vigorously combatted by some, but its justice and fairness will, I believe, be made apparent.

The principal argument to support the inclusion of the unearned increment is that the public service corporation should not be denied advantages that flow to all the surrounding land holders. If a valuation were being made for sale, taxation or rental purposes, the inclusion of the increment would be right. But a valuation for rate making should not include it. In the first place, it is only a potential value. A homesteader can not live on his land, develop and use it, and at the same time realize a return on its unearned increment. He has to sell or rent to secure the advantage of it. If a utilities corporation chooses to rent or sell, it doubtless is entitled to take advantage of the unearned increment, if it can find a purchaser on such terms. Further, the unearned increment of the land does not represent an investment of the producer but of the user. The increment arises from the development of the land contributory to the railroad. It is greatest in sections where the development is greatest. It is in essence a contribution of the community. The community is nothing more nor less than the user in an aggregated

form, and, as we have seen, the user is a co-investor with the producer in public utility properties. Obviously no part of the return on the user's investment should be included in a "fair return" to the producer. It follows, of course, that lands donated, whether by a person, by a commercial body, or by a government, should not appear in the valuation at all.[1]

An objection might be raised in the case of a utility comprising several smaller properties obtained by purchase. It is probable that the existing corporation paid prices for the land involved that were determined by the current prices of adjacent land at the time of purchase. These included the unearned increment to date. This increment should not be included in the valuation of the combined properties for rate-making purposes. If the purchasing investors were willing to agree upon a price including any part of the unearned increment to date of purchase, they were in the place of a man who, to secure a valuable property of forty acres, buys up four ten-acre places. So long as the purchaser uses the forty-acre place himself he gets no return on the unearned increment, except that flowing from increased enjoyment, a better outlook, or more freedom of action. He recovers that portion of the purchase price invested in unearned increment, with or without interest, when he sells. If he never sells, he never recovers it; and moreover, he loses interest on the investment. If a corporation makes such terms, the users can not fairly be required to pay a return to investors on values contributed by the community. The profits of the investors reside in the continuing increment, if such there be; and they can be taken only at the time of sale. It may be that the whole transaction, involving the purchase, holding and sale, does not show a profit. This may frequently occur; but it is no reason why the public—the user—should be compelled to assume the responsibility of guaranteeing such profits. Some transactions are bound to show loss.

One very remarkable contention has been made in connection with the valuation of land. Stated in its simplest terms, it is this: If a utility has secured the land necessary for its activities, this land should be given a value determined by the advantage residing in it above that afforded by the next less desirable land usable for the operations desired. For instance, if a railroad has located in a very desirable pass, the value of the land in the pass should be determined by the saving in expense both in construction and operation over the next possible location in that vicinity. This argument needs no further attention.

Let us now apply this principle of user's investment to the question of depreciation. This is the next important ground of dissention among

[1] Similarly, bonds guaranteed by counties, a procedure not at all uncommon in the southern states in railroad promotion, have no place in a valuation for rate-making purposes.

writers on the subject of valuation for rate making. It is sometimes held that depreciation should be deducted from the original cost as reproduced. Whether valuation, up to the point of considering depreciation, has been according to the method of cost-new or not, it is quite clear from a statement of the principle of user's interest that depreciation should not be deducted. If an assumed case is considered, this will be seen at once. Suppose a public utility has been paying all obligations, meeting all charges for operation, repair and maintenance, providing annual allotments to such amortizing funds as may be practicable, and making a "fair return," and no more, to the investors, at any rate whatever to the user. Providing there has been no accumulation of surplus, the utility has been doing no better than should be expected of it. Suppose now that owing to any cause at all, maintenance can not be such that depreciation is checked or offset. Or suppose that elements—really a large part of many properties—that can not be practicably amortized by annual allocations, require replacement. If no surplus has accumulated and no more than a "fair return" has been made to investors, it is apparent at once that the rate to the user has been too low. The user has not been contributing, in his innumerable, continuous, small payments, an adequate part of the cost of operations. We have seen that the user is the residual investor. Indeed, this fact makes his ethical right to consideration particularly strong. The "fair rate" that he must pay is not fixed, but the "fair return" to the producer is first assured, and the user is then called upon to contribute what is required to operate the property. If the user is not compelled to pay a rate sufficient to provide for depreciation and consequent replacements, the funds must be secured elsewhere, and this means that new investors come in to whom there must be paid a fair return on a sum equal exactly to the depreciation.

Before leaving this question of depreciation, it might be well to treat it from an entirely different point of view, in order to establish undoubtedly the fact that it must be met by the user. Dr. L. I. Hewes, chief of economics and maintenance, of the United States Office of Public Roads, has introduced the term "absolute maintenance" in connection with the upkeep of highways. As an annual matter, it is only an accounting term. It can not, in most cases, be practically applied each year, for it means maintaining the road in its originally improved condition without deterioration. It includes the charges for resurfacing that occur at the end of a period of years. These charges are distributed equally over the years since construction or last resurfacing, and, together with the annual charges for ordinary repair and maintenance, constitute the annual absolute maintenance charges. There can be no depreciation charged off against the property if an absolute maintenance charge is made.

The conditions under which public service utilities operate demand that they be absolutely maintained.[2] Obviously, it is from gross receipts that all maintenance charges must come. It is financially unsound to use investment funds merely to maintain, and if the user is rightly expected to pay a rate that will, after meeting the "fair return," straight operating expenses, interest, taxes, etc., provide a balance sufficient absolutely to maintain the property, that means that there can occur no depreciation to be deducted, and if annual maintenance charges are less than absolute, and depreciation occurs, it is not to be deducted, because the user has contributed less each year than he rightly should. He has been postponing a part of his payment.

If the depreciation is not taken care of by the user, then the producer may relinquish a part of his "fair return" in order to provide for replacement, and we find our depreciation producing a deficit. We are now ready to consider another controverted matter, called sometimes the deficit theory.

This problem can be attacked in exactly the same manner as depreciation, keeping always in mind our ethical principle, which involves the user jointly with the producer as parties having material interests and mutual obligations in the conduct of public service utilities. In establishing the justice of the deficit theory, the fact previously stated, that the user is the "residual investor," is of greatest force. If business under the usual conditions of developing enterprises is insufficient to meet all operating charges, pay interest, taxes and insurance and furnish a "fair return" to the investor, under practical conditions existent, a deficit is the result. As rates could not, as a practicable measure—and can not, even under the system projected—be adjusted during the development period so as always to produce sufficient gross revenues to meet all demands, the user can not, from his own contributions, provide the necessary further funds. His managers—the producers—either advance the funds for him, or, in other words, forego a part or all of their "fair return," or secure such advances from outsiders. In either case, the user must assume the interest charges. It is not desirable that funds be secured from outside sources if the accumulated "fair returns" are in themselves sufficient to meet the demand, so generally such sums are foregone by the producers as are necessary to meet all charges, and true deficits are incurred. The user, as we have seen, must assume the interest charges on additional funds, if such are secured from outside. Similarly, he must assume the interest charges in the shape of a "fair return" on the deficits covered by the producer. The plain way to ac-

[2] This does not consider that some utilities work at full efficiency after about 25 per cent. depreciation due to "normal wear," but the argument is not affected, as absolute maintenance must follow from the point at which permissible depreciation stops.

complish this end is to include in the valuation for rate making the accumulated deficits to date.

We must not stop at this point, however, in our discussion of deficits. The principle we are applying stands for fairness above all things; it is ethical in nature, recognizes rights and obligations which are mutual. If a public service corporation has in the past paid huge dividends, made distributions of stock, and then continued to pay dividends on these paper values; or if future profits, speculative values, have been capitalized and a return made on this capitalization, we are in the opposite position from that involved in the accumulation of past deficits. Early deficits incurred in the development period may long ago have been wiped out. Perhaps surplus funds have accumulated and extensions been made to the original property. In this case, the situation is just as clear as in the former. The returns over and above accumulated past deficits plus a "fair return" should be deducted from the cost-new. In this case the producer has taken more than his "fair return" in the past; the user has contributed more than his "fair rate." An adjustment could be made by having the producer disgorge, but this is not practicable, and the simple and obvious procedure is to permit the producer to retain what he has received, which assumably bears him interest, and deduct it from that capital sum on which the user is to provide a "fair return" in the future.

We are now in a position to discuss surplus, and it will afford another basis of attack on the problem recited just above. Surplus is more easy of definition than most of the elements we have been dealing with. It is the remainder of gross receipts after operating charges, including taxes and insurance, absolute maintenance charges, interest charges, and a "fair return" to investors, have been met. If it exists, it can belong to but one party—the user. The producer should have no benefit from it. The user is the residual investor, the "fair rate" is the dependent function, the user is called upon to make good depreciation, deficits, and to provide a "fair return." But if a surplus is accumulated, the user at last finds something that returns to him. Either the "fair rate" is subject to adjustment, or else the user can accept—and usually would do so under practical conditions—extensions and improvements in the utility. These added values should produce no increased returns to the producer.

If now we apply these principles to the conditions supposed above, involving past unduly large returns to producers, we find that had the parties concerned—the user and the producer—recognized their mutual rights and obligations, and, in consequence, had none but "fair return" been paid to the producer, there would have resulted a large accumulated surplus. As we have seen, this belongs to the user, and if the producer has appropriated it, he should return it, or the user should be relieved

of his obligation to the producer by an equal amount. Thus is our previous conclusion supported.

In the course of this discussion, the expressions "fair rate" and "fair return" have been repeatedly used. These terms need no explanation for the ordinary reader of the subject, but the ethical principle applied throughout this paper has its effect in establishing the character of a "fair return," and to this we may now apply ourselves.

We have seen that the user is the residual investor, he appears to get the small end, he has no personal voice in the management of his part of the utility properties. These circumstances are directly attendant on the nature of the contributions made by the user. These are in large part community values that have cost the user nothing directly in money, or else they are made in small amounts from time to time, and at least a portion of such small, continuous and numerous contributions go to purchase some immediate return. This position as residual investor means that the "fair rate" to the user is adjusted, with many attending conditions, to provide a "fair return." The community undertakes to guarantee, in some measure, the safety of the producer's investment. This party is protected against depreciation or deficit, and always against the effects of competition. The regulations under which the mutual arrangements exist have a legal status—are a part of the law of the land. Here, then, we have a condition free from large risks. In the development period, returns may be delayed; but the producer is assured that he will not lose, that all such withholdings will be made up to him and become a basis of continual "fair return." This statement of the case at once disposes of the contention that a "fair return" should be above ordinary interest rates. In fact, the beam is depressed on the side of a lower return than customary in private transactions. Certainly a "fair return" should never be greater than that expected from a permanent or long term investment in a property free from unusual risks.

Finally, we are ready to discuss profits. Many writers hold that in addition to a reasonable interest on the fund invested, the fair return should include profits. The unusual foresight of promoters, the great ability of managers, the doubts and dangers of loss in early days, are all recited as reasons why profits should be allowed. But, sticking strictly to our last, and recognizing the principle here stated in connection with valuation for rate making, we find that the foresight of the promoters has been paid for in proper underwriting and promoting charges, the doubts and dangers of loss have been removed when the user assumes the responsibility of providing for absolute maintenance, and the ability of the managing officials has been rewarded in the usual manner and met as a part of operating charges. The producer, in his personified aggregate, is, to be sure, fewer in number than the user in his personified aggregate. But, nevertheless, the producer is not a personality, and

nothing is due him for promoting, managing or by way of compensation for hazarding loss.

Further, profits are the basis of speculative activities, and the one thing that must be recognized above all others, and without which no valuation can be made justly or equitably, is that public utilities are not speculative in character. If they become so at any time, the speculative element must be excised ruthlessly and surely.

A point around which much discussion hangs is the character and place of "going concern value." Once we have taken care of absolute maintenance and the deficit theory, together with the accompanying details of surplus and profit, there is nothing left of "going concern." It is an inclusive term to cover matters not fully grasped in the early days of the valuation discussion, and should have no place to-day.

In conclusion, we must admit that in applying any principle to the adjustment of human affairs, the personal element must be recognized. There is always the matter of wise and unwise payments in the construction period; the personal honesty of officials especially during the period of development. What are we to do with the case of a trolley concern that builds to develop a subdivision? If, through greatly facilitated communication, the subdivision prospers, if the promoters of the real estate transaction and of the trolley company are one, if also the real estate deal produces big profits, but the trolley runs at a deficit, what is to be done? It is useless to deny that complications of the most puzzling kind will be found in arriving at valuations for any purpose. Questions innumerable will arise involving equity, the early history and conduct of absorbed utilities, subsidiary companies, and a complexity of others. But if a few basic principles can be established and adhered to; if the courts can be prevented from piling up a mass of conflicting, baseless precedents that will become millstones about the neck of the appraiser; if skilled appraisers are sought; and if the great, the tremendous importance of these valuations and their profound influence on social and economic conditions are recognized, there is a hopeful future for public service utilities, their producers and their users.

THOUGHT IN SCIENCE AND IN SCIENCE-TEACHING

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FOR the sciences as taught in the secondary schools in all parts of the country, there is generally claimed a "training" value in addition to the informational value. In common with the teachers of the so-called "humanities," many of the teachers of the natural sciences claim for their subjects the power to develop in the student certain intellectual and moral qualities. These highly desirable results are reputed to flow from the "mental discipline" involved in the effort to overcome difficulties, in the exact and orderly sequence of the intellectual material, and in the method of the laboratory.

Many psychologists deny outright the claim of any subject to have a disciplinary value. This denial is based deductively on certain modern generalizations as to the workings of the mind, or the break-down of the "faculty" hypothesis; it is based inductively on the results of certain experiments made in recent times, upon the effects of various learning processes. It is the purpose of these notes to base the denial of the general claim upon the results of observations on the mental processes of certain persons who may be presumed to have acquired the full benefits of whatever training the study of science is able to impart, namely, teachers of science. In addition, I wish to point out the direction in which I think it is worth while to look for "educational" results, as distinct from informational results.

Do teachers of science in general exhibit those special virtues which science learning is supposed to cultivate, in a degree above that shown by the average citizen? Or by the teachers of other subjects?

In the matter of *observation,* the teachers of science with whom I have come in contact are not more *comprehensive* than the teachers of history or of languages. The only criterion I have of this is "what kinds of phenomena are noted?" The science teachers are not more catholic in their interests or in their range of observations. On the contrary, I have found many teachers of history and of language who take an intelligent interest in the development of science, as well as in the phenomena that fall within their own specialties; but I know comparatively few teachers of science who take an intelligent interest in matters foreign to their specialties. And their observations, as gaged by their comments and conversation, are as restricted within their respective fields as are their interests beyond. If we consider the *accuracy* of the observations in their own fields, it remains an open

question whether this accuracy is not itself a contributing factor in the selection of their specialties, rather than a result of pursuing the studies. But in so far as the ability to make minute observations on special material is the result of training, it may mean simply the acquisition of a special technique for running a fine-tooth comb over particular classes of objects, and not a general habit of taking in details at a glance. Teachers of physics are not especially acute in noting variations in the leaves of plants that they happen to pass; teachers of biology are not especially keen in observing delicate changes in the facial muscles; teachers of chemistry are not exceptionally alert in discovering the new fashionable angle for the cut of reveres. Whatever excellence of observation any of these may show seems to be confined either to the subject-matter or to the material in which the individual has a special interest. But this is just as true of mathematics teachers and of milliners, who never studied any "science" at all.

The method of science or of the science laboratory is supposed to develop a certain "instinct" for *system* or *order*. My observations do not support the expectation that science teachers are exceptionally orderly in their handling of materials. A working scientist must certainly have some sort of system in his head, but scientific work of a very high grade seems to be quite compatible with personal habits of a very high degree of disorderliness. Science teachers can not guarantee to the fond parents that the science courses will make the children any more careful about hanging up their hats and putting away the books than they were before. It is not to be denied that many individuals received from some well-conducted laboratory their first inspiration to make a place for everything and to keep everything in its place; but it is equally true that a successful science teacher may reside in the same skin as that occupied by a person who only occasionally gets his personal belongings into the right place—at home. At any rate, the science teachers that I happen to know are not as a class more systematic in their handling of materials than are the teachers of other subjects, or than the business men and housekeepers who never studied science at all.

When we extend this principle of order to the matter of time, we find the same failure to generalize the training. Teachers of science within my experience are not more punctual in keeping engagements; they are not more prompt in setting to work when it is time to set to work, or in stopping when it is time to stop; they are not more systematic in planning the work of an hour or of a day. The individual variations seem to be as great among science teachers as among shoppers, and their general efficiency with respect to planning their time to the best advantage is exceeded by many housekeepers and clerks who lay no claim to special training.

When it comes to having system or order in the handling of ideas

that are not parts of the routine work, I have found that science teachers are as easily bewildered and disconcerted by unfamiliar concepts as teachers of mathematics, and much more easily than teachers of history. This may mean that I happen to be acquainted with exceptionally clever teachers of history or with exceptionally stupid teachers of sciences; but it would not be fair to assume this. The general intelligence of the many teachers I have in mind (as this may be judged from casual intercourse in school, in committees, in general contact outside) does not show a correlation to the subjects taught.

The fact seems to be simply that the teacher of science is just as likely to become petrified under suitable conditions as the teacher of any other subject. So far as science teaching has gone in the past, it has not yet established a universally acting dynamic principle in the character or the mind of the student. Not only are new ideas met with hostility, but when he is forced to handle them the science teacher does not show that system in his attack which his training has putatively imparted. If he does show order in analyzing a problem in his own field, this may mean only that he has learned a useful formula for attacking certain types of problems. The value of the "training" should show itself when problems of new types are met.

This leads to the next virtue which science is expected to develop, namely, the *judgment*. We no doubt learn to judge by judging; but I have not found science teachers, in dealing with matters outside their specialties, exhibiting greater deliberation, broader vision or less prejudice than are shown by just ordinary people of "culture." On the contrary, the most complacent and immovable spirits I know are among teachers of science.

It is impossible, from the data at hand, to come to any final conclusion as to the causes of this apparent incompatibility between the results of science teaching, as shown by the teachers, and the possibilities of science teaching as claimed by these same teachers. But some of the causes are near the surface and are worth noting.

The concept *science* is not itself sufficiently definite, judging from the senses in which the word is used. Thus, one science teacher speaks of another as being "too scientific" in his teaching because the latter employs many technical terms in the class room. Technical terminology is here confused with "science"; and any person of common sense can tell you that it is not at all *scientific* to use in teaching such terms as make the work of the pupil unnecessarily difficult. Another teacher prides himself that he has a thorough scientific training, since he is able at a moment's notice to describe the laboratory technique for any experiment or demonstration you are likely to want; and his familiarity with this technique is the result of long and intensive laboratory experience. But we forget that a laboratory helper can acquire all these details

without understanding either their pedagogical purpose or their theoretical significance. One science teacher speaks of another as being "well up" in science, because he knows the names of minerals or of spiders that you and I never heard of; or he knows all the stages in the life-history of some very rare red sea-weed. Here science is confused with erudition that happens to concern itself with objects of nature rather than with words out of books; but erudition is not science in the one case any more than in the other.

Another defect in much of our current science teaching lies in the fact that the method of the *experiment,* which is supposed to be one of the fundamentals in modern science, is often taught as a matter of manipulation rather than as a matter of thought. Thus, in presenting certain types of experiments, the negative instance or control is entirely ignored. A chemical test is given, let us say, for the identification of starch, or for determining its presence. The teacher shows that the addition of iodine solution to starch produces a blue color; the application is immediately made by placing some iodine on bread: the conclusion forced out of the minds of the unsuspecting victims is that bread contains starch! I quote from an elementary biology by well-known teachers:

1. Put a small amount (size of pinehead) of corn starch in a test tube, add water, shake the mixture, and boil it over a gas flame. Pour into the starch mixture thus formed a few drops of iodine. What color is produced?

2. Try the effect of iodine on each of the other food substances as follows: Put a small amount of grape sugar into a test tube; into a second tube put some white of egg (protein); into a third some fat or oil; into a fourth some mineral matter (salt); and into a fifth some water. Add a little water to each and boil as in 1 above to cook each nutrient. Add a drop or two of iodine solution to each tube.

Do any of the colors thus produced resemble at all the color resulting from the addition of iodine to starch?

3. From the preceding, state how you can determine whether or not a substance contains starch.

Or we are to show that water is essential to the germination of seeds; and we are content to rest the case on the fact that seeds supplied with water did under certain—but undefined—conditions actually germinate; or we may accept the conclusion on the fact that seeds without water did *not* germinate—overlooking the equally obvious fact that certain seeds without soap-powder or star-dust also failed to germinate.

One biology teacher, after drilling the simple chemical tests for the nutrients, proceeded to apply the acquired knowledge in true pedagogical fashion, by testing an "unknown." The unknown proved to contain both starch and proteins. The *application* came when the teacher asked, "Well, then, is this substance fit to eat?" An affirmative answer was promptly forthcoming, and there ended *that* lesson. In an

extensively used text-book of zoology, written by a biologist of international reputation, occurs this passage:

> An excised representative sample of hydra will reproduce the whole: but you can not perform this experiment with the frog.

To one who looks upon an experiment as a means of testing hypotheses there is no obvious reason why "this experiment" can not be performed with a frog, or any other beast. But if the experiment is a means for getting certain desired objective results, of course it is impossible to get a complete frog to regenerate from an "excised representative sample"—as we know from experiments!

That the experiment does not always mean to the teacher the same as it does to the investigator may be inferred from the fact that many teachers are not averse to "faking" experiments that are arranged for demonstration purposes. William James tells in one of his papers of his own performance in a physiological demonstration, and he justifies it upon pragmatic grounds. The question I am raising is not one of ethics, but of clear thinking. If the experiment is a didactic tool for presenting concrete, objective processes, it falls into the same category as wall-charts and models. The demonstration experiment need not then be any more "real" than a glass model of the eye or of a diamond. But if the experiment is used by the teacher for the purpose of teaching method in thought or in the solution of problems, the "unsuccessful" experiment should be at least as illuminating and educating as the "successful" one.

A third source of confusion lies in the apparently harmless little word "law." A student of science should certainly know what is meant by a "law of nature"—but we may not expect him to if his teacher does not. Now it is altogether too common to hear teachers of science speak of the laws of nature in exactly the same way as ordinary folks whose notion of "law" is derived from the statutes of the commonwealth or the commandments of the gods. In science a law is presumably a generalization from a limited series of experiential data, not a prohibitive or mandatory order from some superior authority. Our attitude toward Boyle's law, for example, is in no way related to our loyalty to Mr. Boyle. In ordinary usage there may be violations of "law" and such violations are frequently followed by disagreeable consequences. But in "nature" the consequence is not something superimposed by way of punishment or retribution; it is itself a part of the law, and integral in the general process formulated in the law. Laws of nature can not be violated in the sense that statutory laws can be. Laws of health are descriptive generalizations of the conditions under which normal health is maintained. Yet we speak of empirical rules for securing these conditions as also being "laws of health." In practise we may or we may not observe these rules; but we can not *violate the laws.* Morbid conditions also arise in conformity to law. There is

nothing unlawful or lawless in a curved spine or chronic constipation or an accidental poisoning. It is inconceivable that the ordinary pupil will get any very clear idea of "law in nature" from teaching that is as ambiguous as that of most teachers in the matter of *law*.

Ambiguous and misleading use of significant terms shows itself further in connection with ideas of *causation*—which certainly ought to be fundamental in science teaching. A teacher asks the question, "Why is air necessary to a plant?" Now this is a perfectly legitimate question if the meaning is "What is the relation of air to the maintenance of life in a plant?" But I have heard this and similar questions asked when the teachers' meaning was substantially, "What is the evidence that air is necessary, etc.?" In about three fourths of the cases the pupils will answer such a question by saying "Because the plant can not live without it." Teachers will frequently in such cases *teach another answer*—presumably the "right" one—but there will be no clearing up of thought.

Another type of question confuses a vague teleology with physiological principles of function, or with some ecological theory of adaptation. Thus, "Why has the grasshopper longer hind legs than the walking stick? Why has the rose-bush thorns? Why has a fly a shorter proboscis than the butterfly? Why has the bean-blossom a showier corolla than the oak?" These are actual examples of questions asked by teachers of biology in various schools. Strictly speaking, such a question means, "How came this organism to have the character in question—organism here standing for species?" Which no one can answer. The pupil may have read or have heard of the speculations of Darwin or of Lamarck, but if he has, he should have been informed also that they were speculations. I have heard teachers who are regarded as of high merit asking such questions when they meant simply "What is the advantage such an animal has from this character?" Not only is the apparent utility, function or adaptation tacitly assumed by many teachers to *explain* the existence of organs or instinct, but the adaptation itself is assumed to be the "intention" or purpose of nature. The expression "nature's intention" is frequently heard in the class room. It may be impossible to speak in our public schools of the "purpose of God" without prejudice; but it does not seem to be a bit more scientific—and it is much more presumptuous—to speak of the "intention of Nature."

In the matter of intellectual honesty, does the teacher of science show any superiority over other teachers? The science teachers do not appear to me to be less prone than other teachers of my acquaintance to resort to indirect methods of accomplishing practical results. They do not appear to me to be less evasive in their dealings with subordinates or superiors. Pupils are constantly impelled to ask questions suggested

by details in the lesson. Many of the questions are unanswerable in the form given, or in the present stage of our knowledge, or in the present state of the teacher's knowledge. How many teachers say frankly and unequivocally "I don't know"? I have failed to observe that science teachers are less given to that pedantic way of saying "I don't know" which the unsophisticated can not always interpret to mean just that. Here are a few of the questions that I have heard pupils ask of their science teachers without getting a direct answer, or the information that the teacher could not supply the answer, or a reference to some other source of information: Why does magnetism act only on certain kinds of metals? What makes roots and shoots respond to gravity in opposite senses? Why does not a grape-seed germinate inside the grape, where there is plenty of water? Why do sodium and potassium produce different colored flames? Any one can extend the list indefinitely. Many teachers have a favorite way of deferring these troublesome questions to "the next time" in the hope of gaining time for informing themselves—let us hope; or in the expectation that the question will be lost in the shuffle before next time. But the children are either clever enough to see through the trick, or unconsciously absorb the method of indirection to reenforce the lessons they have already learned from the iceman and the grocer.

Where science teachers come in contact with administrative activities, I have found them just as ready to accept the conventional evasions of the strict letter of the law for the purpose of achieving desired ends, as other teachers. And, on the other hand, I have found them just as ready to resort to the strict letter of the law for the purpose of evading the responsibility of making decisions or of taking initiative, as teachers of other subjects.

Teachers of biology—a subject that is supposed to be particularly saturated with the concepts of evolution, which postulate the principle of *constant change*—are among the most reactionary of my acquaintances. I know personally, more or less intimately, over three hundred teachers in high schools; about a third of these are science teachers. Of these science teachers only about a dozen have ever expressed any ideas that would indicate radically progressive notions in matters social, political, ethical, theological or educational; and more than that number have expressed attitudes that would be considered not merely "conservative," but positively regressive in each realm of thought.

The progressive teachers of my acquaintance are predominantly teachers of English and of mathematics. Even in matters purely technical, the majority of the science teachers that I know are either ignorant of the newer ideas about evolution, or extremely suspicious of anything that threatens to undermine the safe and sane doctrines that they acquired as students in college. They are temperamentally static and

their "scientific training" has not made them any more open-minded or progressive. The science teachers of my acquaintance are not more open-minded or more free from prejudice than other teachers, or than other people in various occupational groups. The small number of science teachers who are open to new ideas are probably open-minded not because of their scientific training. The words *foreigner, Jew* and *socialist,* for example, produce in the minds of some four-score science teachers that I know the same kinds of reactions as they do in the minds of just ordinary chauvinists, hooligans and philistines, respectively.

In short, I have found no indication that these science teachers are more deliberate and analytical and systematic in forming judgments upon new problems than teachers of other subjects; nor that they are more progressive in adjusting themselves to new ideas—to say nothing of being on the look-out for new ideas; nor that they are freer from prejudices and conventions of thought.

However, notwithstanding the rather discouraging results of a canvass of my colleagues, I still believe that science teaching offers better opportunities for cultivating certain intellectual virtues than the teaching of other subjects.

A person temperamentally or habitually dishonest can not be expected to teach honesty, if indeed honesty can be taught at all. But even if honesty can not be taught at all, as some maintain, the laboratory presents the opportunity for learning to discriminate between certain truths and certain superficial resemblances to truth—which is in itself a great gain. That is, if a person is to be dishonest, it is desirable that he at least know that he is dishonest, so that he deceive not himself, however he may treat others.

The laboratory presents opportunities for testing objectively the accuracy and coherence of the pupil's language; it devolves upon the teacher to establish an ideal of accuracy. A number of pupils will come to a more or less conscious generalization of the idea, and a more or less deliberate acceptance of the ideal, without any assistance whatever; for most children, however, the teacher's help is needed or the experience in the laboratory will have no "training" value. In the laboratory, too, we may test the logic of a classification, for the inclusion of incompatibles or for the faulty distribution of coordinates, etc. Going through such an exercise a number of times will perhaps develop a certain skill that will show itself in the reduced time of the nth performance, but it will not establish a mental habit unless somehow the teacher makes the practise in such discrimination a part of the conscious purpose of the child.

The teachings of language are arbitrary; they exercise the memory (not in the gymnastic sense, of course) and cultivate faith in authorities. The teachings of mathematics are formal and deductive, and, as

a rule, they leave no room for individual initiative or independence of thought. The teachings of history, so far as the *facts* are concerned, must also be more or less arbitrary and authoritative. But history teaching and language teaching, and even mathematics teaching, are rapidly becoming humanized in a modern, scientific sense.

The teaching of science, introduced into the schools in comparatively recent times, has been too much influenced by the methods of the older teachers of the older subjects. While the other subjects have felt the influence of the scientific age, the science teachers have failed to develop the possibilities of their own material. Science teaching needs indeed to be *humanized,* but not by being assimilated to the mechanical, formal teaching of the older school disciplines, but along the lines of its peculiar possibilities. We must not expect general discipline from special work in science; but we must turn to general application the special ideas and principles of science.

We can humanize our science teaching by relating it to the idea of human *achievement.* Achievement in science is an essential part of human history, and a very significant part. It can be made to appeal to the imagination and to stir the emotions quite as effectively, and to as good purpose, as achievement in other directions. The history teacher may be obliged to neglect this side of his history—at any rate, he generally does neglect it. But the science teacher can not afford to detach the great ideas which he wishes to impart from the animal species in the course of whose evolution these ideas emerged. We can humanize our science teaching by making clear the idea, and making it impressive, that human progress, as illustrated by the growth of science, depends upon most intimate kinds of cooperation; by making the pupils feel the interdependence of the living of all lands, by making them feel our dependence also upon those who have gone before. High-school girls and boys can appreciate the fact that the reason why one carried on the shoulders of another sees farther than the latter is not necessarily the superior optical apparatus of the first.

We can humanize our science teaching by making clear in the thought of the pupil the idea that the progress of science consists of a successive refinement of hypotheses; by teaching them to appreciate the difference between hypothesis and fact, on the one hand, and between fact and conclusion, on the other. We can teach an appreciation of the value of facts as the only sound basis for judgment, and we may hope to establish the habit of searching for facts during the suspension of judgment.

We can humanize science teaching by giving up the attempt to make scientists out of high-school students: that is not our function. It is our business not to make scientists, but to make as many children as possible appreciate first the service of science, and second the method

of science—as a tried and worthy method of solving certain types of human problems. We may incidentally discover that here and there a pupil is worth directing into a scientific career; but that is a part of the general purpose of the school, and not of the specific purpose of science teaching. Now, if we are to make young people appreciate the service of science it will not be merely by establishing in their minds bonds of association between important inventions and the names of the inventors: it will be by making them *feel* the downright solidity of thoroughness and accuracy and honesty and clear vision. If we are to make them appreciate the method of science it will not be merely by helping them to memorize concrete facts, rules of procedure and abstract formulas, it will be by making them take part in analytical thinking about real problems until they have arrived at an explicit realization of what constitutes a valid way of thinking about problems.

We can humanize our science teaching by making the pupils realize that we have no final truth; that science, like life, is a constant becoming. This ought to do something to counteract what has been called the "superstition of science"—that attitude which continues the method of the medieval dialectician, but substitutes some new-sounding phrases for the older categories. The person who confounds evolution with the doctrine of natural selection, the one who has nothing to do with ions because these threaten to disrupt the atom which he acquired in his youth—these are among the men and women with closed systems of thought, who may indeed speak of chromosomes and valency, but who never are scientific.

We need science teachers more than ever. These should be first of all teachers. But the usual tests require that they shall be then familiar with reasonably large bodies of information about plants and animals, or about wheels and polarities, or about atoms and reactions. What is needed more than large bodies of information—which any reader can get out of a half-dozen books—is a habit of clear and honest thinking. This is not to say that the quality in question is not desirable in teachers of other subjects. It is simply to say that in the selection of teachers of science this qualification has been too greatly overlooked.

THE PROBLEM FOR THE RURAL SCHOOL

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WHAT is the real problem now before the rural school? This is a question that is being asked on all sides, and by an increasing number of people. Professional and laymen alike are trying to find out, not only why it is that the rural school has been so much neglected, but in what specific ways it has been neglected; and, what is even more important, what the rural school is really obligated to do.

It is true that the praise of the district school has been sung almost from the dawn of its existence; that the poet, the essayist and the orator have all referred in endearing terms to the little red schoolhouse on the hill; to the district school, the pride of our land and the embodiment of the best principles of American democracy, etc.; and we have continued to believe things about the country school in general which we knew did not apply to any particular case in point. Thus the real and the ideal have managed to avoid a conflict till the issue has become very pronounced, not because the school is any different from what it was a half-century ago, but because the demands upon it have increased in complexity, and so intensified its problem, which it has never solved any too well. And it is because the facts of its inefficiency have been accumulating so rapidly that during the past decade a wealth of literature, technical and otherwise, has been finding a ready consumption. Just what these facts are we ought to know. No policy can be laid down which is in any sense comprehensive if it is not made in the clear light of the real nature and extent of those problems which it is the function of the rural school to solve or help to solve.

It is well to remind ourselves from time to time that in the minds of the founders of our nation, as well as in our own thinking, education is conceived to be essential to our form of government. Yet, if we examine more closely to see just how the school has been handled by the state, we may quickly find that it has never been a definite part of a constructive national or state policy in the broad and comprehensive sense commonly accepted. For while in theory the school has been instituted and espoused as an instrument to be used in the development of political and social permanency, yet in very fact we discover that when this principle or ideal, which is referred to in almost every state constitution, becomes a reality, it is a state concern too much in name only, with such vital matters as support left, in the final analysis, to the locality

for which the school is constructed. (Fortunately notable exceptions to this are increasing in number.) But where this is true, it is plain to be seen that in a district where there is little taxable wealth there must be either a very high tax rate, or the alternative of little school money, and hence a poor school. Thus the state may levy the school tax and distribute it, but when it levies a higher rate in one district than in another, or distributes less to one district than to another, even though that district may actually have more children to educate, it would seem that there are at least some very important ways in which the schools are not state institutions.

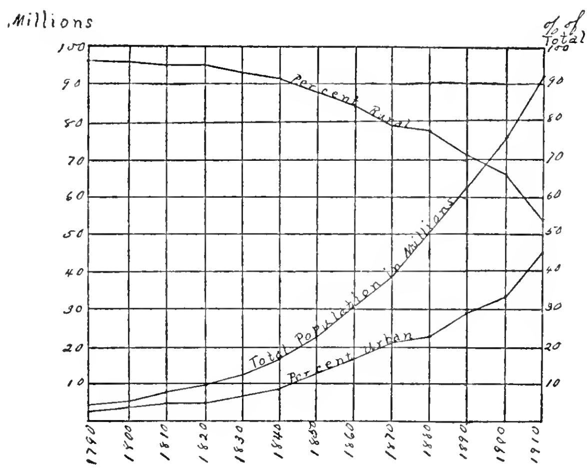
It is because of this interpretation by the state that the rural school, which along with many other phases of rural life, being left desolate by the accumulation of wealth in the cities, has suffered. And by comparison with the city schools its suffering has been very real. For the rural schoolhouse of to-day is of the same general type that was in vogue a hundred years ago; a large percentage of its teachers have not only had no professional training, but are teaching for the first time; the teacher rather rarely succeeds herself, and is often succeeded by one or two others within a single year; one teacher has all the grades and teaches from fifteen to thirty classes daily; poor library and no laboratory apparatus, save some dust-covered curios bought from a clever agent by an unsuspecting school director; no play apparatus or director; no domestic-science or manual training; little agriculture; and little or no supervision. This may not be a pleasant picture, but for the United States as a whole it is not badly overdrawn, in spite of many excellent signs of awakening here and there. But it is only by comparison, point by point, with a modern city system that the real poverty of the country school becomes apparent.

These are the conditions we are becoming conscious of to-day, and they are provoking a serious study of the real underlying troubles. The teacher, the preacher, the farmer, the banker, the legislator, the president, all are asking the same fundamental question, each from his own particular angle. The teacher sees that the country school is not vitally tied up with its problem, the preacher finds that the country church is disappearing, the banker realizes that a more successful handling of the farming problem will aid his business, legislatures are looking to the conservation of the soil and the destruction of farm pests, the national government has looked after the important matter of credit for the farmer, and the report of the Roosevelt Country Life Commission speaks in similar terms. Thus when we are counting the defects of the country school we are only counting one group of symptoms. The trouble is deeper and more far-reaching than any one institution. The problem is therefore not the mere problem of the school, but the whole problem of country life.

We are to ask, then, not what are the present limitations of the country school, but what are these big vital problems which are of such vast concern as to claim the active attention of so many men in high authority. We are concerned to know what is the real function of the country school, and whether or not it is part of a conscious program for handling these larger issues, or whether the state has merely said: let there be a country school, and then sat quietly by with folded hands. This latter may still be entirely too true, but if so it is high time that the state should be taking the constructive side of its problems more seriously.

The country problem is one for all people, urban as well as rural, for in its last analysis the welfare of all rests flat down upon the land. That is not too broad a statement, for though other industries undoubtedly have a future in this country, yet we can not fail to see that it is America's broad and fertile acres that determine her responsibility among nations, as well as her future economic position. Whatever affects the occupation of farming, therefore, is of consequence to the rural situation in general.

A glance at the accompanying chart will impress one with at least one very important change that has taken place in the past century and a quarter.



When our nation was first established there was almost no city life at all, and even in 1800 only 4 per cent. of the people lived in cities of 8,000 inhabitants or over. By 1850 this had increased only to 12½ per cent., after which its increase is very rapid, till in 1910 almost half our total population lived in the city. At the rate of the past decade, the next census will show that here, in the greatest agricultural nation in the world, the few are feeding the many. This means over ninety million consumers, with only about forty-five million producers.

What this change has meant is difficult to state in few words. This shifting in population is effect as well as cause. Parallel with it has gone the development of factories, which has taken many industries to the city which were once a part of farm life. And it is to be remembered that whatever affects the economic life affects also the social life in all its institutionalized expression. So the home life on the farm, the country church, the country school, all have been influenced by these changes. Likewise with the development of machinery, farming is being made more and more scientific. Hand labor is therefore disappearing, and cooperation between farmers along with it. So the old life on the farm, that was in itself a broad education, is gone, and it is the legitimate function of the school to fill this gap. But it is not yet filled, for legislation has constructed a school adapted to the old days, when wealth was evenly distributed, and democratic ideals were best met by systems of local control and local support.

In this age of city-building it is interesting to note the tendency toward the operation of farms by tenants. In 1880 there were 74.5 per cent. of the farms operated by owners. In 1910 this had decreased to 62 per cent. At this rate the absent landlord will be supreme ruler in the course of a few generations. The accompanying table will be illuminating in this connection. True, the price of land has raised

Year	Per Cent. of Farms Operated by			
	Owner	Tenants		
		Cash	Share	Total
1910	62.0	14.0	24.0	38.0
1900	64.7	13.1	22.4	35.3
1890	71.6	10.0	18.4	28.4
1880	74.5	8.0	17.5	25.5

(having almost doubled in the past ten years), and it is necessary, therefore, for each succeeding generation to remain as tenant a little longer than the generation before; true also that the number of farmers who are retiring to a quiet city life, but holding their farms, is increasing; and true that city investors are buying land but not farming it. So, if it is not a wilful desertion of the farm in all cases, it is nevertheless bringing the question of absent landlordism among us, and that is not a wholesome tendency. It should be remembered that this has been the tendency in the face of a vast supply of cheap government land, which will soon be a thing of the past. And now, add to this the further fact that the number of farms under mortgage is on the increase, having risen from about 28 per cent. of all the farms in 1890, to nearly 34 per cent. in 1910, and we seem to complete the evidence that something needs to be done if we are to succeed as an agricultural people.

It will only darken the picture to add that the per cent. of illiteracy

in the country is just double what it is in the city, and this despite the fact that nearly all the illiterate immigrants who come to this country reside in the cities.

The problem of rural life from an economic viewpoint seems broad enough, and the task of the rural school looms large; yet we must add, that while 53.7 per cent. of the people in the United States live in the country, the per cent. of children of school age (6–20) who live in the country is 58.5. That is 53.7 per cent. of the people have to educate 58.5 per cent. of the children; while the other 46.3 per cent., who live in the city, have to educate only 41.3 per cent. of the children.

From the social side there is a problem nearly as great. For even if the telephone, the rural mail delivery, the automobile, and the good roads movements as doing much to make possible a better social life, yet where is the theater, the moving pictures, the library, the high school, the club house, the athletic fields, the parks, the shop windows, the bright lights, the crowd? These are in the city, and they call loudly to the young life in the country. Isolation is the word in the country which corresponds to the word congestion in the city. The play side of life is too narrow, and people die of lonesomeness.

It is not the purpose of this article to suggest the country school as a panacea for all these social, religious, intellectual, and economic ills, but it would urge that a systematic study of the whole problem should be made in order that the appropriate function of each rural institution may be more scientifically determined. What is said here is true only of the United States as a whole, and not of any one section in particular. But a constructive effort should be made in every community to understand the problem as it exists there. And then for its solution we need, not so much a new institution, as a reinterpretation of the function of the institutions we already have. The rural church ought to exist, but it must teach wholesome religion in the place of medieval creeds, and build community churches instead of Methodist or Presbyterian churches. In like manner, the school must drop some of its traditions, quit luring children away to the city, and begin to reconstruct in terms of country life. It must be a state school in more than name, and be a school for old as well as young. The schoolhouse must be open for all kinds of social and intellectual programs, and become the center of community life.

But this can not be done by the various rural institutions working singly, at different fragments of the problem. Concerted effort is needed, and we can not propose a safe plan of reconstruction for the school, or for the church, or for social life, until we know more about the present status and more about the facts which must underlie any constructive program.

The Country Life Commission is a notable example on a large scale

of what ought to be done for every country community. The state should probably take the lead, as Ohio is doing in her rural school survey, and make a complete study of the whole of her rural life. Until this is done, the school and the church will cling to tradition, and the broad cultural side of life on the farm will be neglected. And so long as this is neglected, that long will the social reason for deserting farm life exist, and the drift to the city continue.

If it is not in the province of the rural school to assist in the solution of these problems, by giving to the children a proper understanding of the rural conditions, by providing a center for the social and intellectual life of the community, then all its traditional procedure, all its narrowness which is being so broadly criticized, is justified and represents efficiency. Or putting it another way, if the government, which theoretically exists of, by and for the people, does not attempt to meet these destructive tendencies in our national life, it is following an outworn social and political philosophy. And if the state does try to meet them, and does not use the rural school as a means to that end, it is ignoring one of the most efficient agencies it has, and one whose very meaning as an institution rests in its capacity to render this broad social and intellectual service to farm life.

The problem of the rural school is therefore the problem of the rural people. It is not as narrow as a book, but it is as broad as life. The school must accept its share in these large social, economic, and intellectual responsibilities, and stand ready to assist in the execution of a broad constructive social policy, whose aim it shall be to make rural life not merely tolerable, but wholesome and attractive.

THE EVANESCENCE OF FACTS

By Dr. JONATHAN WRIGHT

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IN looking over some old portfolios, I have lately dragged to light elaborate notes which relate and discuss various facts set forth by the laboratories of this and other lands. Yellow with age, but vivid with the interest and bursting with the importance with which the scientific environment of the day invested them for me, they have set me musing on the vanity of human interests, especially the vanity of scientific interests. I remember the sonorous periods which reverberate from university platforms, the mottoes flaunted on the title page of many a scientific journal, "To the solid ground of nature trusts the mind which builds for aye." The pride, the pomp and circumstance of war burn in a feeble flame when compared with the assurance which fills the bosom and exudes at the lips of the man of science when he contemplates the firmness of the pedestal upon which he stands, the rock of ages, the steel concrete foundation against which dash in vain the skepticism of the scoffer and the voluble waves of theory and ratiocination.

For is not this substructure the product of the unerring interpretation of vision, hearing, of smell and taste and feeling? Vision aided by spherical glasses, aberrations of light and obscurity of outline corrected by the proper means, sound amplified by vibrating plates and confined by hollow conduits, smell—well, there is some doubt about smell—it is a recessive—however, the solidity of the ground of nature as betrayed by the senses, that is, most of them, is such a contrast to the airy superstructure built by deductive reasoning and by the imagination, unrefined by submission to the crucial test of experiment, that it is not worth while to dwell on the fallaciousness of the senses.

However, to go back to my old notes, yellow with age, musty with the dust of the intervening years, like the moths and insects from Faust's old coat when Mephistopheles shook them out, they may sing:

> Willkommen! Willkommen!
> Du alter Patron,
> Wir schweben und summen
> Und kennen dich schon.

But I recognize them only as a particularly uninteresting and lousy lot of lowly organisms. I am not at all tempted to utilize them as foundation stones for the imposing edifice I was secretly longing to build when

I took up the old portfolio. What is the matter with the facts? They seem just a little tarnished; the mind is not tempted to gild them over or rub them up, the imagination refuses to endow them with those winged words which carry newly quarried facts bright and shining to the work table of the appreciative student, unhaunted by any shade of historical perspective. Evidently the time to work a fact into the masonry of science, "the solid ground of nature" upon which her trusting and unsuspicious, non-historical, scientific children love to build, is when it is fresh and when the mortar will cling to it. Coat it over with the incrustations of criticism, the mould of age, and it must be fresh hewed to the point of losing its identity—its susceptibility of identification, I mean,—before it can be appreciated as a part of "the solid ground of nature"—made solid of course by eyes, not really myopic or hypermetropic when they have their errors of refraction properly corrected, made solid in a word by the unfailing, unerring use of sense—a veritable fact, not an old fact, of course, but a new one. It is true that an old fact is often not just the thing to trust to, but a new one, and new ones are so easy to find if you have not wasted your time with the old ones, lends that solidity of support which we love to contemplate in the hierarchical press of science. It unfortunately has come to look a little suspicious in the secular press, but a new fact, really approved by the hierarchy of science, unsmirched by any touch of the imagination and free of any suspicion of deductive birth, is a thing of beauty if not a joy forever. The old facts, though they continue to sing:

> Du hast uns gepflanzt;
> Zu Tausenden kommen
> Wir, Vater, getanzt.

are, I must confess, a pretty "poor run of shad." It is true it does not seem just the way a fact should behave. Its vintage should improve with age. It is undeniable, however, that in really choice circles of science, the old facts are not looked on with favor.

The imagery of Shakespeare, the flowers of eloquence in Demosthenes, need no burnishing, no drapery to hide their age, but the atoms of Democritus and the spheres of Ptolemy need considerable correction, and the cloud of insect facts which swarm up from my old yellow sheets, if not simply disgusting, are at least uninspiring. Is it possible then they lack something? A fact, it is true, should lack nothing. It should stand alone unshamed in its nakedness—for is it not the truth? Is not the truth divine?

The concatenation of circumstance should have nothing to do with it. The contemporaneous adornment it borrows from its environment must be non-essential. I do not know how many facts can pass through this crucible of criticism unscorched. All that I can say is that I have never

met with an old fact among the countless tons of them under which our library shelves groan which I am certain would not betray to the eager experimentalist of whom we are so proud many a crack and many a blemish. To the observant dilettante or to the ingenuous, earnest student—if one can be called such who flits often across the whole domain in which truth is sought, it is apparent that different tests are applied to the genuineness of the information acquired.

The physicist concludes he has something material because when his electrons are fired through a tube he can see the flash or hear them ring a bell and so count them. The physiologist or the biochemist concludes a certain organic juice is present because he can perceive the effects of its diastase or the serologist can see the clouding or clearing of the fluid in his test tube. The geologist draws certain conclusions from the scar on the hillside or river bank, the archeologist from the presence or absence of certain forms of the architrave or of certain metals in the implements he finds. Such evidence for the establishment of facts as is satisfactory to the sociologist or psychologist or archeologist is scorned by the astronomer and the physicist, while the statistician is still more intolerant. "Chacun à son métier" with a shrug of the shoulder is the answer given to extraneous criticism by the delver in each domain for hidden facts, yet in a certain tacit way it is felt that the physicist in the making of a flash or in the ringing of a bell, and the statistician in counting them, has really the better grasp on reality, until along comes some king of physicists like Lodge or Crookes or some skilful fencer like Bergson, some iconoclast like Driesch, and shows that these things are not physical at all, but are knots in the ether or metaphysical entirely, or the Lord knows what, and the dilettante says (to himself, if prudent): "Well, what is the test of Reality anyhow, what is a fact? It seems to depend on the method"; and he goes his way with his own private opinion of the claim that the methods of science are something sacrosanct and apart from other demonstrations of the grounds of belief.

Truth is eternal, of course, but whether there are some truths which are not facts or some facts which are not truths may be left to the logicians, and other former inhabitants of the fanes of science, discredited dwellers in the temples of truth. The mantle of the sophist, the glamor of the logician clothes other forms and illuminates the halls of other shrines. Other prophets are now accustomed to have their dictum greeted as if: "A fonte relatum Hammonis." The same befitting solemnity, the same sepulchral dignity, again clothes the dispenser of new truths as of old shone around the prophets with the oriflamme of truth. The modern prophet, however, draws his inspiration not from the gushing fountains of the imagination set playing by some Pagan or Christian divinity, but from the solid foundation of facts laid down by the un-

erring and unfailing senses, aided of course usually by the microscope and the stethoscope, but solid fact nevertheless. No deduction need apply; no fiery imagination can play around a fact. The supreme tragedy of nature, Huxley reminded Spencer, was one of his theories killed by a fact. Reason indeed must play a minor rôle in the new theocracy. Man indeed has been accustomed to lean upon it but:

> Ein wenig besser würd er leben
> Hättest du ihm nicht den Schein
> Des Himmels Licht gegeben
> Er nennt's Vernunft und braucht's allein
> Nur thierischer als jedes Thier zu sein.

When the fact comes to be builded into a structure of any use to mankind, of course the "light of Heaven" must be employed, but not for a fact alone. That shines by its own effulgence. It would appear, I confess, that the fact should shine for the babe as well as for the sage, but after all sight and hearing and smell (that Judas of the senses—why is it always necessary to reckon with this atavistic weakling?), need interpretations; certain conclusions, not of course deductively but inductively—mark the difference—must be drawn from those peripheral stimuli which ring a bell in the caves of thought. This is entirely different from the circuitous ratiocinations which formerly disfigured the face of science. Pure science is direct induction, as distinguished from the impure science in which the heavenly beacon plays too conspicuous a part. Truth is apt to be lost if we get too far from the peripheral stimuli; just how far, it is at present inconvenient to determine. At any rate, it is now universally recognized that the sources of knowledge are entirely different from former sources of knowledge, so elongated in degree that the difference is fundamental. Without this appreciation of the difference between an interpretation of external peripheral stimuli, revealed to us by the senses, and the conclusions arrived at by the philosopher who sat in his tub or by the deductive sage who constantly contemplated his umbilicus, one is apt to lose sight of the glory of modern science. One method we readily believe was fallacious, the other we know to be unfailing.

This change in the methods of science began when the old method had advanced about as far along its old paths as we have along the new ones. The change (it is uncertain whether we are to reckon its inception from Roger Bacon or Lord Bacon) gradually became so emphasized that under Cuvier at the French Academy even discussion was frowned upon. It is true that France is no longer the exclusive home of science or even the chief home of science. Science finds a favorite residence amidst the fogs of Germany, where, owing to the idiosyncrasies of etymology, discussion is a tiresome, but alas, not a neglected occupation. Indeed, there is well-founded suspicion that science has advanced

as much by discusssion as by direct observation, but there seems to be a smell of heresy about this. At least the phenomenon is familiar. The cash-register method of Cuvier, whereby facts were supposed to be recorded but not discussed, presents some flaws in its title of supremacy. Possibly this is because there is really some incompleteness in application. The interposition of the function of the cerebral cortex seems to a certain extent unavoidable. In so far then we are, even with Cuvier's classical conception, obliged to accept some modification. "Das Ding an sich" is essentially a figment of the reasoning faculties of the German mind, and the attempt to grasp it in the interest of pure science has always been somewhat of a failure.

In musing over these old notes then, I am led far astray in an attempt to explain just why the old facts do not present that alluring aspect to me which they once did. True in the words of the poet I may well question:

> Are they still such as once they were?
> Or is the dreary change in me?

Indubitably the "warped and broken board" of the poet's simile does not take the painter's dye as it did when fresh sawed from the mill. The chill of age we know brings the carping criticism to the front which the blush of youth hides behind its inexperience, but I never heard that wisdom was the latter's handmaiden rather than the servant of the former. Nevertheless, it is well to compare the inspiration of the recent revelation with that of the discovery of the old knowledge and the force of the suggestions I have shadowed forth in my musings will not appear entirely negligible.

What then becomes of the old facts? Peripheral stimuli, transmitted from without through the organs of special sense and interpreted by the cortical gray matter of the brain, have eventuated not only in records carved on stone and scratched on brass, but they have left their still more lasting impress on the social inheritance of countless generations of men—evidently from far beyond the period when historical records began to be preserved for us. The peripheral stimuli, direct observation, with as little interposition of gray matter, illuminated with as little of the heaven-bestowed light as possible, were the origin of these beliefs—these facts—just as are the red rods we see by the help of convex glasses which we now call tubercle bacilli.

The archeologists tell us that time plays curious pranks with the most resistant and stubborn materials. For many years the old story of the Phœnician sailors' discovery of glass beneath their camp fire on the sea sands of the shore was an attractive one, but evidently the manufacture of glass goes far back of the time when the Phœnicians were masters of the sea. In some of the material dug out of the soil, once pressed beneath the feet of men of the most remote antiquity, a streak

of a little different color is noted. Carefully brushing away this mouldering matter, in the center is still found a thin streak of glass. The dust in which was encased this flint-like product of man's ingenuity was once glass too, but the whole has crumbled away to this mere sliver which alone serves to betray the nature of the whole. In this crumbling disintegration we may see an apt illustration of how those facts, yielded by direct observation to the cerebral cortex of primitive man, have ceased to preserve their recognizable outlines. In order to get some idea of what they were, the archeologist must go with the sociologist to the study of those remnants of primitive man still to some extent uncorroded by the pressure of the environment of civilization. Malay magic, the astounding beliefs unearthed by modern travelers, innumerable legends fantastic to the civilized mind, so devoid of point and so obscure of origin as to be not only incomprehensible but even devoid of interest, are the revelations which greet the inquirer. At first without a clue, this is simply a bewildering mass, confusion thrice confounded. Gradually, however, it becomes evident to the student that all this has arisen from the direct observation of an external environment, of an ever-pressing, an ever-intruding nature with which primitive man struggles. His method of the acquisition of facts, however, we find quite similar to that of Cuvier—observation, assertion, suppression of ratiocination, ignorance of logic—the true inductive method.

When Diogenes studied the universe from his tub and bade Alexander stand out of his sunshine, he probably did not realize that Alexander had pushed the forest back and had started the conquest of tropical nature and had given Diogenes time for the study of his umbilicus, given him the leisure for reflection. The savage has it not. So Diogenes and his tribe knew not direct observation and concluded they could get along without it—in spite of the Stagyrite, who was soon to make an abortive attempt to weld the two weapons being forged for man in his future search of the truth. Back and forth these two tendencies of man in his quest surged for thousands of years. Finally man, by availing himself of the invention of the convex glass found in the ruins of prehistoric Nineveh, by perfection in the accuracy of the measurement of the curves and angles studied by Euclid and his predecessors, by throttling those who to preserve their own autonomy had hitherto prevented it, brought about the bursting forth of a flood of external stimuli—new facts pressing on man, intruding on him like the primeval forest did on his primeval ancestor, fairly forcing him into Cuvier's attitude—record facts, never mind what they mean—there is no time for the study of the umbilicus at present.

And so again their evanescence becomes manifest. Crumbling disintegration sets in. Time with its mordant acid and alkalies encrusts the bright new glass. Back and forth vibrate the forces of the micro-

cosm as well as those of the macrocosm, the spiritual tendencies and the intellectual methods of man. It is a universal law. Perhaps a static equilibrium means death—all things tend to that so far as we know. But will it never be possible to establish a unity of the two methods of seeking truth? Surely they are not wholly antagonistic—they are not essentially hostile forces like attraction and repulsion, like positive and negative electricity. Can we not have, now Cuvier is dead—peace to his ashes—a little pause—a little time for discussion, a little space for a contemplation of the umbilicus—a little space for logic and criticism in the Centralblatts and other cash registers?

It *is* the concatenation of circumstance, to repeat a former phrase, and not the fact itself which lends it charm. The naked truth no one ever saw, except the nymph who perished at the sight. The facts of sense, like those of the prophet, like those of the poet, like those of the philosopher, are relative, not real, and the results of such musings as I am indulging in can lead the seeker after truth only to the conclusion that each is but the facet of a whole of which our conception is the less complete and the narrower the more exclusively we tread the path illuminated solely by one aspect of the truth. He who knows nothing of the imagination, of the workings of logic, of the inspiration of the poet and the prophet, he who is ignorant of the past and finds no comfort in the speculations of the prophet as to the future, is badly equipped for the interpretation of the impression of the senses. No life is a rounded life without a touch of something more than that of materialism. The method of science which rests solely on that is fatally defective. It withers the powers of youth and it favors the approach of a premature intellectual sterility from which there is no escape but in the silence which falls upon those who have not heeded the warning in their youth.

Thus musing, the old yellow papers are cast aside for fresh tablets, but with the consideration that in science it does not matter much, since the evanescence of facts, not at once built into the structure which forms the woof and web of contemporaneous thought, is soon evident to the seeker after truth if he digs deep enough.

FOREIGN ASSOCIATES OF NATIONAL SOCIETIES, III

By Dr. EDWARD C. PICKERING
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A PAPER entitled "Foreign Associates of National Societies" was published in The Popular Science Monthly, Volume 73, page 372. A second paper on the same subject is contained in Volume 74, page 80. Lists were prepared of those who had been elected as associate members in the physical and natural sciences, by the seven leading societies of the world. To secure impartiality, the great nations of the world were arranged in the order of population. Omitting China and Japan they are Russia, United States, Germany, Austria, Great Britain, France, Italy, and are here designated by the letters, R, U, G, A, B, F, I. The societies are the Imperial Academy of St. Petersburg, the National Academy, the Royal Prussian Academy, the Royal Academy of Sciences in Vienna, the Royal Society of London, the Institute of France, and the Royal Academy of the Lincei. All the foreign members of a society are regarded as foreign associates. The list already published contained all persons who were foreign associates of two or more of these societies. It may be claimed that this is the most unprejudiced list of eminent men ever selected. It would seldom happen that any person, not worthy of the honor, could be elected into one of these societies. The chance that he could be elected into two is so small that it may be neglected. The first list was published in 1908, and since then more than a third of the members have died. Moreover, under existing conditions, it will probably be impossible for many years to secure an unprejudiced election of foreigners into these societies. It appears, therefore, to be the last chance to prepare an impartial list of the men most eminent in the physical and natural sciences, in the opinion of their contemporaries.

Table I. contains, in successive columns, the names of each man selected as described above, his residence, his department of work, date of birth, age on election into each of the societies and, if not living, his age at the time of his death. The date of the list is January 1, 1914, but the last column is probably complete to January 1, 1915. The letter *a* is added to indicate those men elected since 1908. It will be noticed that, in three cases, men have been elected and died during the last six years.

Table I. may be discussed in a variety of ways. The numbers may be grouped according to the societies, countries or sciences. Examples of some of the conclusions which may be derived are given below.

TABLE I

LIST OF MEMBERS

Name	Country	Science	Birth	R	U	G	A	B	F	I	D
Agassiz, A.	U. S.	Zoology	1835	...	*31*	60	54	56	52	53	75
Albrecht, C. T.	Prussia	Geography	1843	...	...	...	...	...	67	64	*a*
Appell, P. E.	France	Mathematics	1855	56	...	...	...	...	*37*	49	*a*
Arrhenius, S. A.	Sweden	Physics	1859	44	49	...	48	51	52	52	...
Auwers, A.	Prussia	Astronomy	1838	35	45	*28*	56	41	54	50	...
Bachlund, O.	Russia	Astronomy	1846	*37*	57	...	...	65	49	...	...
Baeyer, A. von	Bavaria	Chemistry	1835	57	63	*39*	50	50	51	59	...
Bakhuyzen, v. d. S.	Holland	Astronomy	1838	...	...	...	...	...	58	72	*a*
Barrois, C. E.	France	Geology	1851	46	57	...	61	62	*53*	58	*a*
Beneden, E.	Belgium	Zoology	1846	56	...	41	56	...	55	53	64
Bonnier, G. E. M.	France	Botany	1853	59	...	...	61	...	*44*	...	*a*
Bornet, E.	France	Botany	1828	74	73	...	...	...	*38*	...	82
Boss, L.	U. S.	Astronomy	1846	64	*43*	64	...	...	...	...	66*a*
Brögger, W. C.	Norway	Geology	1851	47	52	...	61	51	53	62	...
Bütschili, O.	Baden	Zoology	1848	46	...	*49*	56	...	...	...	...
Cannizaro, S.	Italy	Chemistry	1826	63	...	62	63	63	68	*47*	84
Chauveau, J. B. A.	France	Agriculture	1827	...	...	...	...	62	*59*	63	...
Christie, W. H. M.	England	Astronomy	1845	47	...	...	...	*36*	51	...	...
Ciamician, G.	Italy	Chemistry	1857	55	...	...	...	...	56	*36*	*a*
Crookes, W.	England	Physics	1832	...	81	...	...	*31*	74	72	...
Darboux, J. G.	France	Mathematics	1842	53	71	55	65	60	*42*	48	...
Darwin, G. H.	England	Geography	1845	62	59	...	63	*34*	62	52	68
Davis, W. M.	U. S.	Geography	1850	...	*54*	60	...	...	63	...	*a*
Deslandres, H. A.	France	Astronomy	1853	...	60	...	...	...	*49*	55	*a*
Dewar, J.	England	Physics	1842	...	65	...	...	*35*	...	67	*a*
Ehrlich, P.	Prussia	Biology	1854	...	50	...	...	56	...	53	...
Engelmann, T. W.	Prussia	Biology	1843	...	...	*55*	52	...	52	58	66
Fischer, E.	Prussia	Chemistry	1852	47	52	*41*	50	47	48	47	...
Gaudry, J. A.	France	Geology	1827	...	...	73	...	68	*55*	70	81
Geikie, A.	England	Geology	1835	73	66	54	60	*30*	56	63	...
Gill, D.	England	Astronomy	1843	42	55	47	...	*40*	53	63	71
Golgi, C.	Italy	Zoology	1843	62	...	...	60	...	...	*47*	...
Gordon, P.	Bavaria	Mathematics	1837	...	...	*63*	...	...	67	67	75
Graff, L. v.	Austria	Zoology	1851	...	54	49	*48*	...	...	...	...
Groth, P.	Bavaria	Geology	1843	40	62	...	...	68	...	62	...
Haeckel, E.	Saxony	Zoology	1834	...	...	...	38	...	...	65	...
Hale, G. E.	U. S.	Astronomy	1868	...	*34*	...	42	41	40	43	*a*
Hann, J.	Austria	Geography	1839	51	...	50	*33*	...	...	...	...
Heim, A.	Switzerland	Geology	1849	...	64	...	...	47	57	...	...
Helmert, F. R.	Prussia	Geography	1843	64	...	*57*	...	65	56	54	...
Hering, E.	Saxony	Biology	1834	71	...	...	61	68	...	65	...
Hermann, L.	Prussia	Biology	1838	...	...	...	...	67	...	73	*a*
Hertwig, R. v.	Bavaria	Zoology	1850	55	...	*48*	55	...	...	...	...
Hilbert, D.	Prussia	Mathematics	1862	...	45	...	49	...	...	41	...
Hildebrandsson, H.	Sweden	Geography	1838	69	...	...	...	...	74	...	*a*
Hill, G. W.	U. S.	Astronomy	1838	...	*36*	...	...	64	65	75	76
Hittorf, W.	Prussia	Physics	1824	...	...	*62*	87	...	76	80	...
Hoff, J. H. van't	Prussia	Chemistry	1852	43	49	*44*	44	45	53	49	59
Hooker, J. D.	England	Botany	1817	41	66	54	...	*30*	49	58	94
Huggins, W.	England	Astronomy	1824	77	80	71	...	*41*	50	59	86
Jordan, M. E. C.	France	Mathematics	1838	57	...	...	...	...	*43*	57	...
Kapteyn, J. C.	Holland	Astronomy	1851	57	56	...	...	...	58	...	*a*
Karpinski, A.	Russia	Geology	1847	*49*	...	...	50	...	...	51	...
Kayser, H.	Prussia	Chemistry	1853	49	...	...	...	58	...	...	*a*
Klein, F.	Prussia	Mathematics	1849	46	49	...	51	36	48	34	...
Koch, R.	Prussia	Biology	1843	41	60	*61*	60	54	60	45	67
Kohlrausch, F.	Prussia	Physics	1840	54	61	*55*	...	55	...	59	70
Kronecker, U.	Switzerland	Biology	1839	...	62	...	...	...	...	58	75
Lacroix, A.	France	Geology	1863	46	...	...	47	...	*41*	45	*a*
Lankester, E. R.	England	Zoology	1847	48	56	...	...	*28*	52	51	...
Larmor, T.	England	Mathematics	1857	...	51	...	...	*35*	...	54	*a*
Le Chatelier, H. L.	France	Chemistry	1850	62	...	55	...	...	*57*	...	*a*

TABLE I—*Continued*

Name	Country	Science	Birth	R	U	G	A	B	F	I	D
Leydig, F. von........	Wurttem-berg	Biology	1821	76	...	*66*	...	80	...	...	87
Lippmann, G..........	France	Physics	1845	67	...	55	...	51	*41*	64	...
Lister, J..............	England	Biology	1827	...	71	...	70	*33*	66	...	86
Lockyer, J. N.........	England	Astronomy	1836	68	...	...	...	*33*	37	47	...
Lorentz, H. A.........	Holland	Physics	1853	57	53	52	58	52	50	49	...
Mascart, E. E. N......	France	Physics	1837	54	...	58	...	55	*47*	62	71
Metchnikoff, E........	Russia	Biology	1845	...	...	...	66	50	67	66	*a*
Michelson, A. A.......	U. S.	Physics	1852	...	*36*	...	...	50	48	54	...
Mittag Leffler, G......	Sweden	Mathematics	1846	50	...	...	...	50	54	53	...
Mohn, H.............	Norway	Geography	1835	72	...	65	...	...	...	...	...
Murray, J............	Scotland	Geography	1841	56	71	...	...	*55*	...	71	73*a*
Nansen, F............	Norway	Geography	1861	37	...	...	...	...	34	39	...
Nathorst, G...........	Sweden	Botany	1850	51	...	50	36	...	...	...	...
Neumayer, G. B. von..	Saxony	Geography	1826	...	...	*70*	77	73	...	...	83
Newcomb, S..........	U. S.	Astronomy	1835	61	*34*	48	69	42	39	60	74
Noether, M...........	Bavaria	Mathematics	1844	...	...	*52*	...	...	59	47	...
Ostwald, W...........	Saxony	Chemistry	1853	43	53	*52*	51	...	...	...	...
Pawlow, I. P..........	Russia	Biology	1854	*47*	54	...	...	53	...	53	...
Penck, A.............	Saxony	Geography	1858	...	51	*48*	47	...	...	51	*a*
Pfeffer, W. F. P.......	Saxony	Botany	1845	63	58	*44*	59	52	55	54	...
Pfluger, E. F. W.......	Prussia	Biology	1828	66	...	*72*	...	60	...	71	82
Picard, E.............	France	Mathematics	1856	39	47	42	...	53	*33*	45	...
Pickering, E. C........	U. S.	Astronomy	1846	62	*27*	60	...	61	61	55	...
Poincaré, H...........	France	Mathematics	1854	41	44	42	49	40	*33*	34	58
Ramon y Cajal.......	Spain	Biology	1852	...	...	...	...	57	...	54	*a*
Ramsay, W...........	England	Chemistry	1852	49	52	44	51	*36*	43	55	...
Ranvier, I. A.........	France	Zoology	1835	47	...	...	...	...	*42*	53	...
Rayleigh, J. W........	England	Physics	1842	54	56	54	60	*31*	48	59	...
Retzius, G...........	Sweden	Zoology	1842	53	67	51	59	65	53	65	...
Richet, C............	France	Biology	1850	63	...	...	...	...	...	61	*a*
Righi, A.............	Italy	Physics	1850	46	...	...	...	57	...	*48*	...
Roscoe, H. E..........	England	Chemistry	1833	...	...	...	...	*30*	53	74	...
Rosenbusch, H........	Baden	Geology	1836	...	68	*51*	68	...	63	65	...
Rutherford, E.........	England	Physics	1871	...	40	...	41	*32*	...	...	*a*
Sars, G. O...........	Norway	Zoology	1837	59	...	61	...	...	...	...	...
Schiaparelli, E. V......	Italy	Astronomy	1835	39	65	44	39	61	44	*40*	65
Schulze, F. E.........	Prussia	Zoology	1840	55	...	*44*	42	...	...	...	...
Schwarz, H. A.........	Prussia	Mathematics	1843	54	...	*49*	...	...	52	45	...
Schwendener, S........	Prussia	Botany	1829	...	...	*50*	70	84	71	70	...
Seeliger, H...........	Bavaria	Astronomy	1849	64	59	*57*	46	...	...	59	*a*
Strasburger, E.........	Prussia	Botany	1844	66	54	*45*	...	57	56	49	69
Suess, E.............	Austria	Geology	1831	70	67	69	*36*	63	58	52	83
Thomson, J. J.........	England	Physics.....	1856	57	47	54	...	*28*	55	47	...
Thomsen, J...........	Denmark	Chemistry	1826	...	...	74	...	76	...	57	83
Tieghem, P. E. L. v....	France	Botany	1839	69	...	...	51	...	*38*	66	75
Treub, M.............	Java	Botany	1851	...	...	49	...	48	37	...	59
Tschermak, G.........	Austria	Geology	1836	76	...	45	*39*	...	61	47	...
Valdeyer, H. G. G.....	Prussia	Zoology	1836	58	...	*48*	71	...	68	...	...
Voigt, V.............	Prussia	Physics	1850	...	...	*50*	...	63	...	48	*a*
Volterra, V...........	Italy	Mathematics	1860	48	51	...	...	50	44	*39*	*a*
Vries, H. de..........	Holland	Botany	1848	...	56	65	...	57	65	54	...
Waals, J. D. v.........	Holland	Physics	1837	...	76	63	...	...	63	66	...
Walcott, C. D.........	U. S.	Geology	1850	45	*46*	...	...	...	...	51	...
Waldeyer, W..........	Prussia	Zoology	1836	58	...	*48*	71	...	68	...	...
Warming, J. E. B......	Denmark	Botany	1841	...	...	58	...	...	63	65	...
Weismann, A..........	Baden	Zoology	1834	...	79	*63*	77	76	...	...	80*a*
Wiesner, J. v..........	Austria	Botany	1838	74	...	61	*54*	...	71	64	...
Wilson, E. B..........	U. S.	Zoology	1856	...	*43*	57	...	...	...	47	*a*
Zeuthen, H. G.........	Denmark	Mathematics	1839	...	...	...	...	...	61	63	...
Zirkel, F.............	Saxony	Geology	1838	...	65	*49*	45	59	...	61	74

Table II. gives the designation of each society, the country it represents, the year of its foundation, the number of resident members, the number of foreign members and the number of members represented in Table I. The latter sometimes exceeds the present number of foreign associates, owing to deaths and the election of resident members. The care taken by each society in electing members is shown in the last four columns. They give the number first elected by each society, the number first elected of the members of the seven societies, the number last elected of the members of seven societies, and the number not yet elected of the members of six societies. When a member is elected in two societies in the same year, both are included.

TABLE II

SOCIETIES

Des.	Country	Found	Res.	For.	Soc.	F.	F7	L7	6
R	Russia	1725	70	97	79	30	5	3	1
U	U. S.	1863	133	49	64	7	..	6	1
G	Germany	1700	37	78	68	15	2	..	5
A	Austria	1847	67	45	56	14	2	6	7
B	Great Britain	1645	472	47	72	14	3	..	..
F	France	1795	77	125	82	21	3	2	..
I	Italy	1603	106	106	94	31	5	1	..

The Lincei is the oldest of the societies, and the Institute of France has the largest number of foreign associates. The Royal Society, the next oldest, has much the largest number of resident members, in fact nearly as many as all the others put together. If any rigid system were adopted for the election of members, each would evidently be elected first into the Institute of France, then into the Lincei, and so on, in the order of numbers. The skill shown by the Russian Academy and the Lincei in selecting members is indicated by the large number of first elections. It was a great triumph for each of them to have elected five men who were not members of either of the other societies, and then to be followed by all of the others. The small number elected by the National Academy is not justified by the number of foreign associates. On the other hand, it is not creditable to a society to have been the last to elect, or to have failed to elect those whose ability had already secured their memberships in the other six societies. Judged by this standard, Austria has overlooked 13 men, the United States 7 and Germany 5. Of the 13, Austria has overlooked 5 astronomers, 3 physicists and 2 mathematicians.

The results of a grouping according to countries are contained in Table III. The name of the country is given in the first column, followed by the number of memberships of 7, 6, 5, 4, 3 and 2, by the total number, the total number of societies, and the number of societies per

member. The last two columns give the number of new members, and the number who have died.

TABLE III

COUNTRIES

Country	7	6	5	4	3	2	All	Soc.	Av.	New	D.
Prussia	4	2	3	6	4	3	22	97	4.4	4	6
England	3	5	1	3	5	..	17	83	4.9	3	5
France	2	2	2	3	8	1	18	74	4.1	7	5
U. S.	1	2	1	2	4	..	10	44	4.4	4	4
Saxony	1	..	1	3	1	1	7	29	4.1	1	2
Italy	1	1	1	..	3	..	6	27	4.5	2	2
Bavaria	1	..	1	1	3	..	6	25	4.2	1	1
Austria	1	..	2	..	2	..	5	23	4.6	..	1
Sweden	1	1	..	1	1	1	5	22	4.4	1	..
Holland	1	..	1	1	1	1	5	21	4.2	2	..
Russia	..	..	..	3	1	..	4	15	3.8	1	..
Norway	..	1	..	..	1	2	4	13	3.2	..	..
Baden	..	..	1	1	1	..	3	12	4.0	1	1
Denmark	..	..	..	..	2	1	3	8	2.7	..	1
Switzerland	..	..	..	..	1	1	2	5	2.5	..	1
Belgium	..	..	1	..	..	..	1	5	5.0	..	1
Scotland	..	..	..	1	..	..	1	4	4.0	1	1
Wurttemberg	..	..	..	..	1	..	1	3	3.0	..	1
Java	..	..	..	..	1	..	1	3	3.0	..	1
Spain	..	..	..	..	..	1	1	2	2.0	1	..
All	16	14	15	25	40	12	122	515	4.2	29	33

It appears from Table III. that the total number of men in Table I. is 122 and that they have a membership of 515, 16 of them are members of all seven societies, and 14 of six. On January 1, 1909, the number of members was 93, on January 1, 1914, it was 89. As in the previous publication, Prussia is ahead of any other country in men, membership and in membership in all seven societies. The average membership is, however, much less than that of England. The progress in France appears from its seven new members, and in the United States by its four new members, equalling in number those of Prussia. Six years ago the United States had no more members than Saxony, although the population was twenty times as great. The total number elected shows an excess of three, although the number living is only one greater, owing to the great loss by death, including the two leaders, Newcomb 7, and Agassiz 6. It is interesting to compare the numbers of Austria and Germany, including Prussia, Saxony, Bavaria, Baden and Württemberg, with England, France, Russia, Belgium and Scotland, and with the nine remaining countries. The number of members in these three groups are 44, 41, 37; of members of all seven societies 7, 5 and 4; of memberships, 188, 181 and 145; of new members, 7, 12 and 10; of deaths, 12, 12 and 9. These numbers are nearly equal, with a slight advantage for Germany.

A grouping according to sciences is contained in Table IV. The

name of the science is followed by the number of members in 7, 6, 5, 4, 3 and 2 societies, the total number of members, the total number of societies, the average number, the numbei of new members and the number of deceased members.

TABLE IV

SCIENCES

Name	7	6	5	4	3	2	All	Soc.	Av.	New	D.
Mathematics.....	2	2	1	2	6	1	14	59	4.2	3	2
Astronomy......	3	3	2	3	4	1	16	75	4.7	6	6
Geography......	..	1	1	2	4	3	11	37	3.4	5	3
Physics.........	2	2	3	4	4	..	15	69	4.6	3	2
Chemistry.......	4	1	..	1	4	1	11	52	4.7	3	3
Geology.........	2	1	4	3	4	..	13	62	4.7	2	3
Botany.........	1	2	3	..	7	..	13	56	4.3	1	5
Zoology.........	1	1	2	3	6	2	16	60	3.8	2	3
Biology.........	1	..	..	6	2	4	13	45	3.5	4	6
All.............	16	13	16	24	41	12	122	515	4.2	29	33

Chemistry is conspicuous in Table IV. from the large number of members of the seven academies, notwithstanding the small total number of members. Biology and geography may be regarded as somewhat new sciences. At least, comparatively few doctors were members of these societies half a century ago. Accordingly, we find but few having membership in 5, 6 or 7 societies. It is not surprising that the number of zoologists is large, considering the breadth of the subject, and the number included in this profession. On the other hand, the total number of astronomers is small, but the number included here is relatively large. The average membership is also equal to that of chemistry and geology. It is probably due to the interest and rapid growth of astrophysics. In mathematics, the country most largely represented is France with 5 members; in astronomy, United States, 5, England, 4; in physics, England, 5; in biology, Prussia, 5. Great Britain is the only country represented in each of the sciences. Prussia has no geologist on the list, France no geographer, and the United States, no mathematician, chemist, botanist or biologist.

BOTANIZING EXCURSIONS IN BORNEO

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WITH ships plying to the remotest lands, it is now a comparatively simple matter for the traveler to visit almost any part of the tropics. Indeed, these fascinating regions are now so easily reached that it is becoming difficult to find any country that has not been exploited to such an extent that much of the original vegetation, and with it the rarer animal forms, have been exterminated.

The planter of tea and coffee, of rubber and bananas, sweeps away the jungle in all the more accessible regions, and the traveler often must make long and arduous journeys before he can see the country in its pristine state.

However, there are still many places of comparatively easy access which richly repay the scientific traveler for any slight inconveniences to which he may be subjected.

No part of the world is richer in interesting forms of life, both animal and vegetable, than portions of the East Indies, especially the great Malayan Archipelago. Java with its unrivaled luxuriance of vegetation and magnificent scenery, is now on the regular tourist route, and is familiar to many travelers, scientific and otherwise. The larger sister islands, Borneo and Sumatra, are not so often visited by the tourist, and still contain large tracts of unexplored country. When as a small boy I first read Wallace's wonderful book on the Malay Archipelago, I determined that some day I should see for myself the wonders of these far-off islands in the Eastern Seas. In 1905–06 a sabbatical year gave me my first experience of this beautiful region, and, so satisfactory was that visit, that I looked forward to my next sabbatical leave to renew my acquaintance with the East Indies and to extend my explorations to Sumatra and Borneo which I had not visited on my first trip.

Much the greater part of the huge island of Borneo is still an unknown wilderness whose wild inhabitants render it a perilous region for the explorer. The coastal region is fairly accessible and there is no great difficulty in reaching the main ports. Dutch Borneo, comprising the major part of the island, has been but little exploited when compared with the extraordinary development of Java.

The rest of the island, except the small native state of Bruni, is under British influence, although not strictly British territory. A recent visit to Sarawak proved to be full of novelty and interest, as in some respects the country is unique.

The story of the young Englishman, James Brooke, who became Rajah of Sarawak, reads like the most exciting romance. Under his wise but firm rule, and that of his nephew and successor, the present Rajah, Sir Charles Brooke, who was closely associated with his uncle in the stirring events which accompanied the pacification of the country, a territory as large as England has been redeemed from absolute anarchy and has become a peaceful and prosperous community. Formerly a nest of pirates and head-hunters, where no man's life or property was safe, Sarawak is now a contented and thriving country, where the rights of the humblest native are scrupulously safeguarded.

In this remote island these two Englishmen have ruled as absolute monarchs over a mixed population of Malays, Chinese, Dayaks and various other savage tribes, who all now recognize their indebtedness to the men who have freed them from the intolerable oppression of the native rulers and the constant incursions of the fierce pirates who formerly infested the whole coast of Borneo.

The present Rajah has carried out zealously the policy of his predecessor. This policy has aimed at developing the country primarily for the benefit of the natives, rather than to throw it open to exploitation by foreigners. At the present time the Europeans, mostly English, number but a few hundred in a territory as large as England, and these are nearly all government officials. This country retains its original conditions to a greater degree perhaps than any other Eastern settlement, and the life of the people must be much as it always has been. Although Sarawak has no railways or telegraphs, nor various other "improvements," the traveler will find life not only quite tolerable, but indeed quite delightful and intensely interesting.

Every week an excellent steamer sails from Singapore for Kuching, the capital of Sarawak, and two days on the shallow China Sea brings the traveler to the Sarawak River on which Kuching lies. The scenery along the coast is very fine, bold mountains coming down to the sea and forming magnificent rugged headlands. The mouth of the Sarawak River—or rather the delta—is guarded on either side by a fine mountain some three thousand feet high. Of these two mountains, Mt. Santubong is especially imposing, rising abruptly from the sea, its flanks clothed with primeval forest, the tall trunks sometimes rising a hundred feet without a branch.

Like most tropical tidal streams, the Sarawak River has developed an extensive delta. The low muddy shores are covered with dense mangrove swamps whose exposed mud flats are the haunts of crocodiles and many other less formidable creatures. Among the latter are myriads of curious mud fish which run about in the mud like lizards, or even climb up the roots of the mangroves. These odd creatures with their big heads and goggle eyes are among the queerest of the fish tribe. Bright

blue crabs are also extremely common, and scuttle away to their holes as the boat approaches the shore.

Further up the river and along the narrow channels the bank is often fringed with dense masses of the Nipa palm, whose long, graceful leaves are extensively used throughout the Malayan region for thatch, and also for covering the sides of the native houses. Another palm, the Nibong (*Oncosperma filamentosa*), may often be seen forming groves behind the Nipa zone. This beautiful palm has a tall, slender stem and a crown of extremely graceful feathery leaves.

As the saltness of the water decreases, in ascending the river, the mangroves give way gradually to a variety of other shrubs and trees, supporting many climbing plants and with their branches often loaded with epiphytes. These epiphytic growths, comprising an astonishing variety of ferns and orchids, and other less familiar types, are a marked feature of this intensely humid region.

Back of the belt of shrubs and low trees immediately bordering the river the tall trees of the forest proper now appear, the outposts of the prodigious forests which still cover most of the wet lowlands of Borneo.

Most of the native settlements are along the rivers, which are almost the only avenues of communication except narrow forest trails. These river-people are Malays and the little thatched houses, raised on posts well above the ground, or actually over the water, are much like those one sees everywhere throughout the whole Malayan region. Plying up and down the river may be seen the picturesque native boats, usually having a thatched shelter, which not infrequently serves as a dwelling for these aquatic people. Squatted at the bow, dressed in a gay sarong, and often with a brightly painted sun hat, the owner may be seen propelling his gondola-like craft rapidly and gracefully along the stream.

Kuching, like all of the larger settlements of Malaya, is essentially a Chinese town. Much of the business of the place is in the hands of Chinese, and, except for the government buildings and the dwellings of the Europeans, the architecture is characteristically Chinese. Some of these structures, including several temples, are excellent samples of Chinese architecture, and are very picturesque, the ornamentation often being really admirable in its details. Highly colored glazed pottery in elaborate and often attractive designs is used lavishly in the decoration of the more pretentious Chinese buildings.

The water front is crowded with Chinese and Malay craft, among which the Singapore steamer and the Rajah's yacht seem rather out of place.

Opposite the town, on a sightly hill, lies the Astana, the Rajah's palace, an attractive but quite unpretentious building surrounded by beautiful gardens. Adjoining it is a picturesque but not especially formidable-looking fort. This structure, with the buildings of the

Borneo Company on the opposite bank, contrasts strongly with the typical Chinese architecture of the rest of the city.

The population is about equally made up of Chinese and Malays, the latter occupying a special quarter on the outskirts of the town. A small number of Tamils from southern India and an occasional Sikh from the northern Indian provinces add variety to a decidedly variegated population. The Chinese women often adopt the gay Malay dress and may easily be mistaken for Malays. The latter are fond of bright colors, and a bevy of native women in their gay sarongs and delicately tinted jackets would be hard to beat as a color study. In Sarawak especially they also affect veils of various bright tints which they drape about their head and shoulders with all the grace of a Spanish woman's mantilla. Indeed, the artist in search of novel and striking color studies could not do better than to pitch his easel in Kuching.

The steamy hothouse atmosphere of Sarawak is of the true equatorial type. Kuching, lying within a degree of the equator, has a uniformly hot and humid climate, under whose forcing influence the vegetation attains a luxuriance which few places, even in equatorial lands, can equal. All the commoner forms of tropical vegetation abound. Palms, bamboos, bananas, orchids and the other plants familiar to those who know the tropics grow everywhere, and the gardens in Kuching exhibit a wonderful profusion of rare and beautiful trees and shrubs. Moreover, the stems of the palms and the trunks and branches of the other trees are laden with ferns, orchids and other epiphytes in bewildering profusion, while creepers with brilliant flowers of every hue are draped over the fences and clamber up the trees.

In the immediate vicinity of Kuching the original forest has mostly disappeared; but in many places the second growth of trees is of good size, and there is a dense undergrowth composed of a great variety of shrubs and herbaceous plants.

One does not have to go far, however, to see samples of the primitive forest, which is very difficult to explore, as the ground is usually a swamp, or else is covered with an impenetrable thicket.

Ferns are abundant, both epiphytic and terrestrial species. Among the most characteristic are species of Gleichenia forming dense thickets, and some very beautiful climbing ferns of the genus *Lygodium*.

Pitcher plants (*Nepenthes*) are extremely common, as they seem to be everywhere in Borneo.

Among the showy flowers noted about Kuching were various Acanthaceæ and Melastomaceæ, and perhaps the most striking plant is *Wormia pulchella*, a shrub belonging to the Dilleniaceæ. It is a common plant of the Malayan region, and its big golden yellow flowers and handsome foliage make it extremely ornamental. Sometimes a bright scarlet *Æschynanthus* was seen, climbing up the trunk of a tree, but this was not very common.

A number of interesting liverworts were collected at Kuching, but, as is usual in the tropics, these are more abundant at higher elevations.

Every season in Sarawak is a "rainy season," but the official rainy season includes the months of November to March, and I can testify from experience that this *is* a rainy season. During the months of December, January and February (1912–13), over one hundred inches of rain fell in Kuching.

As might be expected, this great rainfall contributes to an extremely rich and varied native flora, and Sarawak offers an especially inviting field to the botanist.

Not the least serious problem that confronts the traveler is that of transportation. Except in the town and in the immediate vicinity of Kuching, almost the only means of transport are the streams or else forest trails which are not feasible for either saddle or pack animals, and especially in the low lands are often largely under water. This makes expeditions into the magnificent forests anything but a pastime, and involves not only great fatigue, but also incidentally the discomforts of swarms of mosquitoes and leeches, the latter being especially numerous and voracious in the Bornean forests.

The various native tribes, Land and Sea Dayaks, etc., are of great interest to the ethnologist, but as my interests were chiefly botanical, and my time very limited, I was obliged to leave Sarawak with only the most cursory observation of these interesting savages.

One of my principal objects in visiting Sarawak was to secure specimens of two rare ferns, *Matonia sarmentosa* and *Macroglossum alidæ,* as yet known only from this country, and the first collecting trip undertaken was in search of these.

Through the kindness of Mr. J. C. Moulton, director of the Sarawak Museum, who accompanied me on this trip, I succeeded in accomplishing my object in a highly satisfactory manner.

We left Kuching before daylight in one of the launches of the Borneo Company, and watched the dawn come up behind the dense jungle reflected in the glassy surface of the broad river. In the delicious coolness of the early morning our launch plowed its way up stream, breaking the mirror-like surface of the river, in which were reflected the brilliant tints of the eastern sky. A dense wall of verdure, spangled here and there with white, yellow and purple flowers, bounded the stream on either side.

By eight o'clock we reached our landing place, and after a good breakfast, proceeded by "trolley" for about half an hour to the government bungalow, where we had arranged to camp for a few days while making our collecting trips.

The Bornean trolley is rather a different affair from what one associates with the word in America. The track is an extremely narrow

gauge affair, and the cars are tiny things, consisting of a platform about three feet by four. These are propelled by a man standing on the platform and pushing the car along with a pole. At Bau, in the neighborhood of our bungalow, there are the most important gold mines in Sarawak, and these trolleys are used for transporting ore and other freight. The "passenger coach" has a single seat with a foot-rest. These cars are extremely cranky, and upsets are usually part of the regular program. On an expedition from Bau, my trolley was a two-man power affair, my propellers being a Sikh policeman and a convict in his charge. We were going along famously, when, at a sudden turn the car jumped the track, and the tiffin basket which was resting between my legs jumped also! There was an ominous sound of breaking glass and a strong alcoholic aroma pervaded the atmosphere. Alas! the bottle of Scotch our kind host had thoughtfully provided for our refreshment was shattered to fragments—the soda-water bottles survived.

No further accidents occurred, and we soon reached the end of the line and set off for the jungle-clad base of the limestone crags which were our objective point. After pushing through a dense growth of coarse grass and wading a couple of shallow streams we reached the base of the cliffs, and, after eating tiffin, proceeded to explore the caves with which the rocks are honeycombed. In one of these caves, whose opening lay a hundred feet or so above the foot of the cliff, and which could be reached only by scaling a crazy, more than half-rotten native ladder, the fern we were in search of was seen hanging from the roof of the cave, fifty feet or more above its floor, and quite out of reach. However, after we left, our host arranged with some of the Dayaks, who are accustomed to climb the walls of these caves in search of the edible bird's nests which abound in them, to return with ladders and poke down the clusters of ferns, which were afterwards sent us in Kuching.

These caves are of all shapes and sizes, and are the haunts of the peculiar swift, whose nests, composed of a mucilaginous secretion, are considered such a delicacy by the Chinese.

Matonia sarmentosa is known only from a few limestone caves in Sarawak. A second species, *M. pectinata,* was for a long time supposed to be confined to Mt. Ophir in Malacca. It has now been collected at several stations in the Malay Peninsula, and the adjacent islands. I collected it on Mt. Santubong, and it is also reported from Mt. Mattang, both mountains of Sarawak.

The next morning a second trolley trip took me to the locality where the second fern, *Macroglossum Alidæ,* for which I had come to Sarawak, had been discovered by my host, who was able to give me exact directions for finding it; and I shall not soon forget my sensations when, just where we had been told, we found our plant—a magnificent fern with stately erect fronds more than four yards long. A happy morning

was spent collecting a fine series of specimens for future study, and well content I returned to Bau for tiffin.

Before returning to Kuching a day was spent exploring Mt. Sarambo, a place of special interest to the naturalist, because it was one of the places where Wallace made some of his most important collections in Borneo more than fifty years ago. My companion, Mr. Moulton, showed me the site of Wallace's house, where he had himself camped a couple of years before.

On Sarambo there are a couple of small communities of Land Dayaks who received us very hospitably, regaling us with green cocoanuts whose water was most refreshing after our hot climb.

My most interesting experience in Borneo was a week spent on Mt. Mattang, about ten miles from Kuching, but more conveniently reached by a rather roundabout route by water. This mountain was *tabu* for some reason, and consequently was avoided by the Land Dayaks, who, from time to time, have cleared most of the lower hill slopes in the neighborhood. Except for some relatively small clearings, planted to tea and coffee by the Rajah, the mountain is still covered by magnificent virgin forest. The Rajah built a small bungalow about forty years ago in this clearing, an unpretending, but sufficiently comfortable building, which was kindly placed at my disposal during my stay on the mountain. The site was formerly occupied by a temporary structure erected by the well-known Italian botanist, Beccari, who in the sixties spent a long time in Sarawak and made extensive collections on Mattang. These included many new species. Beccari called his dwelling Valombroso, and this name was transferred by the Rajah to his bungalow.

Accompanied by my Chinese boy and half a dozen coolies carrying the necessary impedimenta for a week's camp (including a crate of chickens and one of the huge pineapples for which Sarawak is famous) I was soon comfortably established, and, for the time being, monarch of all I surveyed.

The surrounding forest is an intensely interesting one. Gigantic trees bound together by great lianas, like huge cables, and with their trunks and branches often quite covered with a profusion of epiphytes, rose from a dense undergrowth of palms, giant ferns, rattans and a host of other strange tropical growths.

The wet banks were covered with beautiful ferns, liverworts and mosses and, although, as is usually the case in the tropical jungle, flowers were not conspicuous, there were a number of very beautiful ones. One of the prettiest (*Didymocarpus*) had small fox-glove-shaped pale purple flowers borne on slender stems rising from a rosette of very dark green, almost black leaves, exquisitely veined with snowy white. These dainty plants grew abundantly on the mossy banks, mingled

with delicate ferns, and made a picture of exquisite beauty. Several showy orchids were occasionally met with, and a straw-colored rhododendron (*R. Salicifolium*) was found in considerable numbers in one locality. A common and showy shrub of the upper forest was a species of *Ixora,* whose clusters of scarlet flowers were not unlike some of the *Bouvardias* which are sometimes grown in our greenhouses.

Ferns in great variety, ranging from tiny filmy ferns, looking like delicate mosses, to magnificent tree ferns, thirty or forty feet in height, abounded everywhere and furnished some interesting specimens.

As usual in the mountain forests of the tropics, epiphytic ferns are abundant, as well as striking species of epiphytic Lycopodiaceae. Besides the genus Lycopodium, represented by several species, the curious *Psilotum flaccidum* was occasionally seen. This plant, whose affinities are not quite clear, grows on the trunks of tree-ferns.

As evening fell the air fairly vibrated with the noise of innumerable insects—cicadas, grasshoppers and crickets, to which were added the pipings of tree toads and the bass booming of bull frogs. One felt curiously remote from all civilization, realizing that the nearest white man was miles away.

The weather was decidedly uncertain with a good deal of rain, and due no doubt largely to the moisture, the wet banks, the decaying logs and dead leaves and twigs on the ground, gleamed at night with an uncanny radiance. A little gully back of the bungalow glowed with this weird luminosity and would have made a fitting setting for some incantation scene. This phosphorescence, while not unknown in temperate regions, is very much more marked in the steaming tropical jungle.

A few days also were spent at the base of Santubong, the mountain lying on the opposite side of the delta of the Sarawak from Mattang, from which it differs much, in both its form and vegetation.

This striking mountain rises abruptly from the water, and although of no great height—barely three thousand feet—its steepness and fine contour make it a most imposing object.

A typical Malay fishing village lies at its base on the river side. On the seaward side is a broad beach interrupted at intervals by shelving ledges of rock and with here and there small patches of mangroves. Along the upper boundary of the beach is a belt of vegetation made up for the most part of a number of trees and shrubs characteristic of the Malayan "Strand forest."

The largest trees of this belt are *Casuarinas,* looking like straggling pines, and next in size is a species of *Terminalia,* a tree with the branches arranged in regular tiers and covered with big glossy leaves. Somewhat similar in appearance, but not closely related botanically, is *Barringtonia,* with big white flowers not unlike those of *Eucalyptus,* but very much larger, and beautiful dark green shining leaves. A yellow

Hibiscus, very much like the hau tree (*Hibiscus tiliaceus*) of Hawaii (perhaps identical), was also abundant. A most characteristic small tree or shrub was a screw pine (*Pandanus*), with long slender leaves arranged in a dense spiral, and big heads of fruit, the color and size of ripe pineapples. Of the flowering shrubs, much the showiest was a species of *Wormia* with big golden yellow flowers and handsome foliage. There were also several leguminous shrubs with yellow and purple flowers. A considerable number of climbing plants occur, among them several species of *Ipomœa* very much like our common morning glories. A species of *Gnetum,* with clusters of showy salmon-pink berries, was also common along the shore.

The ascent of the mountain is decidedly arduous, as the trail is very steep, and at times it is necessary to scale the face of almost sheer rock ledges, where one must pull one's self up by the roots of trees or by clinging to such shrubs and roots as could find lodgment in the rock crevices.

The forest is comparatively open, and did not offer much collecting until the summit was reached. Here the forest is composed of gnarled and dwarfed trees whose trunks and branches are moss-covered and serve as a foothold for a host of beautiful epiphytes. The latter included two superb rhododendrons with snowy white and brilliant flame colored flowers; a number of interesting orchids and several pitcher plants (*Nepenthes*), one of which *N. veitchii,* is one of the finest of the genus, with pitchers a foot or so in length.

The ground was covered with a dense cushion of moss, in some places sphagnum much like that found in our northern bogs, and seeming rather out of place in the tropics.

The great forests of Borneo are hardly equalled in the variety and size of the trees of which they are composed. As in other parts of the Malayan region, the most important timber trees belong mainly to a family, Dipterocarpaceæ, which is quite unrepresented in the New World. The Dipterocarps are often trees of great size, with straight trunks which may rise a hundred feet or more without a branch, and yielding timber of great value. There are also many leguminous trees, remotely related to our own locusts and honey-locust. One of these, the tapang (*Abauria excelsa*), is the tallest tree yet measured in the Malayan region. Beccari mentions one of these two hundred and thirty feet in height.

Many other trees, unfamiliar to the American botanist, are components of the Bornean forest. Wild figs and banyans are conspicuous, and several species of *Artocarpus,* related to the cultivated bread-fruit, and also wild species of durian and mangosteen, the two choicest fruits of the eastern tropics.

A few types, however, appear less strange. Oaks of several species

occur, even at sea-level, and in the higher mountains are a number of coniferous trees, mostly, however, of genera which do not occur in America.

The most characteristic genera of conifers in the Malayan region are *Agathis*, to which belongs also the Kauri pine of New Zealand, and *Podocarpus*, also well represented in the latter country. Another Malayan coniferous type is *Dacrydium*, which also extends to the Australasian region.

Borneo, probably, has more species of palms than any other area of like extent in the world; but these are often small and quite inconspicuous forms nor else they are climbing species, rattans, which are quite different in appearance from the typical palms. There are, it is true, a good many large and striking palms, but as a rule they do not dominate the vegetation to the same extent as in equatorial America.

The screw pines, or pandans, have already been referred to, and these very peculiar plants are a most striking feature of the eastern tropics and one quite absent from the New World. They may attain the dimensions of trees, and there are numerous species occurring from sea level to a height of four thousand to five thousand feet. The strange pitcher plants of the genus *Nepenthes* constitute another peculiarly Old World type, and these attain the greatest development in Borneo where they are very common and occur at all elevations up to eight thousand feet or more. These interesting plants, which one may occasionally see in hothouses, differ a good deal in the structure of their pitchers from our American pitcher-plants; but, like the latter, these pitchers are insect traps. The pitchers in *Nepenthes* are borne on tendrils at the tip of the leaf, and are often of very graceful form and beautifully colored.

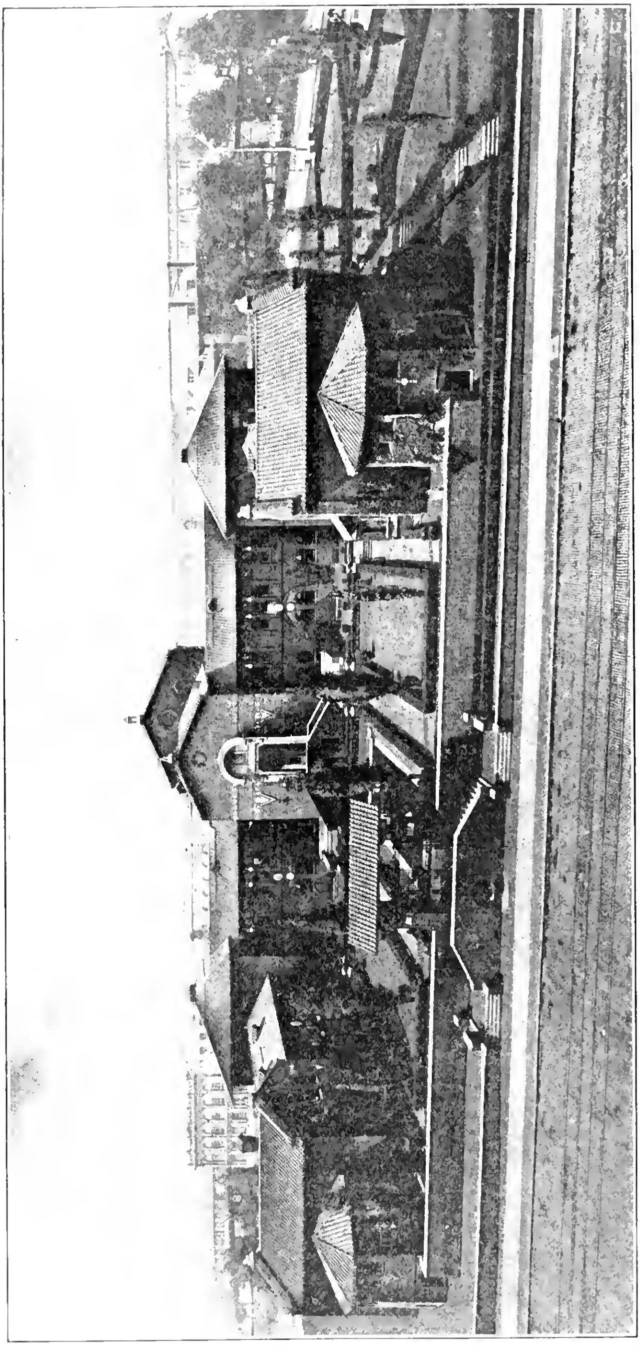
As in all wet tropical countries, Borneo has a great many species of Araceæ, some with gigantic leaves five or six feet long, looking like huge callas. Others, *e. g.*, species of *Amorphophallus*, have enormous leaves much divided and produce immense flowers with a most evil scent. Others, again, are climbers and clothe the trunks of trees in a luxuriant drapery of bright glossy leaves.

One naturally looks for many orchids in such a country as Borneo, and in fact the number of species is very large; but, as every collector knows who has visited the tropics, it is only rarely that showy orchids are abundant enough to make a striking display. The great majority of orchids are small plants with insignificant flowers which would be quite overlooked by any one but the botanist. There are, it is true, a great many orchids of extraordinary beauty in Borneo, but these are for the most part rare and are only occasionally met with in flower. Two handsome orchids are common in the gardens about Kuching, *Vanda teres* and *Arundina speciosa*, both of which flower freely. Another

pretty orchid, which at intervals blooms in great profusion, is extremely common, growing on trees. This is known locally as the dove orchid (*Dendrobium crumenatum*). It has the peculiar habit of flowering all at once over a large area, and for a single day the long sprays of beautiful white sweet-scented flowers may be seen by the thousands. The next day they are all withered and not a single fresh flower can be found.

As might be expected, the constant moisture favors a luxuriant growth of ferns, mosses, fungi and lichens, which show a bewildering variety of forms, and a marvellous luxuriance. These lower plants, except the ferns, have received comparatively little attention, and a magnificent field is waiting for the botanist interested in these.

It was with deep regret that I said good-bye to this fascinating country, and to the kind friends who did so much to make my brief stay a pleasant and profitable one. Some day, perhaps, I may be fortunate enough to return and explore further the botanical treasures of this wonderful land.



The Museum of the University of Pennsylvania.

THE PROGRESS OF SCIENCE

THE CONVOCATION WEEK MEETINGS

THE American Association for the Advancement of Science together with a large number of national scientific societies affiliated with it held at Philadelphia, as had been anticipated, a meeting of more than usual magnitude and interest. The University of Pennslvania is always a generous host, and not only placed at the disposal of the visiting scientific men its laboratories and lecture halls, but was able to provide in Houston Hall an admirable headquarters for registration, council meetings and informal gatherings, while the luncheon served daily in the gymnasium and the evening reception given by Provost and Mrs. Smith in the Museum, offered further opportunities to meet old acquaintances and to form new ones.

Dr. Charles W. Eliot, president emeritus of Harvard University, gives distinction to any meeting over which he presides, and the address of the retiring president, Dr. Edmund B. Wilson, professor of zoology in Columbia University, supported the thesis that scientific eminence is likely to be associated with literary and artistic skill. The program of the meeting, consisting mainly of titles of addresses and papers, filled a volume not much smaller in size than a number of THE POPULAR SCIENCE MONTHLY, and it is obviously impossible to refer even by title to such a series of papers, summing up a great part of the scientific work accomplished in this country during the past year. As there were some two thousand scientific men in attendance and a considerable number of visitors from the city, good audiences were provided even when twenty or thirty meetings were being held simultaneously.

A new feature of the meeting was a session of the Committee of One Hundred on Scientific Research appointed a year ago. Professor E. C. Pickering presided, and reports were presented by subcommittees on research funds, the attitude of colleges and universities to research, the better recognition and greater encouragement of research, the selection and training of men for research, and the research work of industrial laboratories. Committees were appointed on research work under the government, research work on the Pacific coast and the use of the research funds of the association, which latter committee is timely, in view of the fact that Mr. Colburn, one of the fellows of the association, last year made to it a bequest which may amount to over one hundred thousand dollars.

The association will meet next summer in San Francisco and the neighboring universities and next winter at Columbus. Dr. W. W. Campbell, director of the Lick Observatory, was elected president, and most of the vice-presidents were elected from among the scientific men residing on the Pacific coast, their names and work indicating how actively that region is engaged in important scientific research.

The societies devoted to physiology, anatomy and biological chemistry met this year at St. Louis, the geographers, historians and philosophers at Chicago, and the economists and sociologists at Princeton. It is planned to have once in four years a special convocational week meeting in which all scientific men and scientific societies will be invited to join, the first to be in New York two years hence.

After the close of the other meetings, there was held in New York City on January 1 and 2 a gathering of university professors, who organized a new society to be known as the American Association of University Professors, intended to accomplish for teachers in our higher institutions of learning the objects attained in kindred professions by the American Med-

ical Association and the American Bar Association. Professor John Dewey, of Columbia University, who had been chairman of the committee on organization, presided at the meeting and after the association had been formed was elected its first president. Professor Arthur O Lovejoy, of the Johns Hopkins University, who had been secretary of the committee on organization, presented plans which had been drawn up by the committee. An opening address by the chairman outlined the needs and purposes of such an organization, and this was followed by a number of general addresses, after which most of the time during the three sessions was devoted to discussion of the plans and objects of the association, as embodied in the constitution, which was ultimately adopted in a provisional form.

THE PRODUCTION OF IRON ORE IN 1914

THE mining of iron ore and the manufacture of iron are regarded as a valuable index of commercial prosperity and interest attaches to the report of Mr. Ernest F. Burchard, of the U. S. Geological Survey, according to which the quantity of iron ore mined in the United States in 1914 is estimated to have been between 41,000,000 and 42,500,000 long tons, and the quantity shipped from the mines to receiving ports and iron-manufacturing centers between 39,500,000 and 41,000,000 long tons. These estimates are based on preliminary reports from 52 of the important iron-mining companies which represent the principal iron-producing districts and whose combined output in 1913 was more than 90 per cent. of the total tonnage of iron ore mined in that year.

The average decrease in quantity mined by these 52 companies was 33 per cent. compared with their output in 1913, and if this average decrease should hold for all the iron-mining companies in the United States the total output of iron ore in 1914 should approximate 41,440,000 long tons, compared with 61,980,437 long tons mined in 1913. A curve of iron-ore production would therefore show the output of 1914 to be about on a par with that of the years 1905 and 1911. Coincident with the decrease of 33 per cent. in ore mined the iron ore shipped from the mines by the same producers decreased also 33 per cent., and if the shipments for the whole country are figured on this basis the quantiy of ore shipped should approximate 39,810,000 long tons, compared with 59,643,098 long tons shipped in 1913.

In the Lake Superior district, where about 85 per cent. of the domestic iron ore is mined, the average decrease in production was about 37 per cent., thus indicating a total production for that district of about 32,915,000 long tons in 1914, compared with 52,518,158 long tons mined in 1913. The shipments of ore from this district apparently decreased about 34 per cent., and accordingly the shipments should approximate 32,790,000 long tons in 1914, compared with 50,168,134 long tons in 1913.

According the preliminary reports the stocks of iron ore at the mines apparently increased more than 500,000 long tons during 1914, so that the total stocks at the close of 1914 should range between 13,400,000 and 13,500,000 long tons, compared with 12,918,633 long tons on hand at the close of 1913. These figures are, however, subject to greater uncertainty than the other estimates, because the returns to the survey are based largely on estimated data.

Officials of the iron-mining companies are almost unanimous in reporting great depression of trade during 1914. Prices generally were 50 to 75 cents a ton lower than in 1913—as low as or lower than those of 1912 and 1905. The depression in the iron industry affected seriously the lake carrying trade, which depends largely on the transportation of ore from the Lake Superior district to ports at the head of Lake Michigan and at the foot of Lake Erie. During the later part of the autumn probably as many iron mines

SIR WILLIAM OSLER.

were closed or running on half time as at any other time for many years, and owing to the present inactivity in the industries which consume iron ores and to the accumulation of considerable ore stocks in the hands of the consumers, the iron-mining companies are not expecting great activity in the early part of 1915.

SIR WILLIAM OSLER

ON the occasion of the celebration of the twenty-fifth anniversary of the Johns Hopkins Hospital last October a crayon portrait of Sir William Osler by Mr. Sargent, here reproduced, was presented to the hospital through Professor William S. Thayer, who spoke as follows:

The precious gift it is my privilege now to offer to the hospital is but another reminder of him who, though absent in person, has been with us and in us and around us in spirit from the beginning of this gathering. What have been his contributions to medical science, what his inspiration and efforts and example have been to this institution, are so familiar to us all that it would be impudent to mention them. Would that we could put into words the influence that the man has had upon our lives! How much of that which is best in us is due to him and to his example! In all the fifteen years of my close and constant association with him I never knew him to do a hasty or an inconsiderate act, and I never heard him speak an unkind word of any man. Of how many can one say this? He is like Maeterlinck's true sage, in whose presence discord and strife and misunderstanding are impossible. In losing him we felt that we had lost our best friend and adviser, but he left us a legacy of tolerance and forbearance and charity that is among the richest of our possessions. This whole institution is replete with memories of the man; and no statue, no tablet, no portrait can bring him more vividly to our minds. But there will be others who follow after to whom our poor words will convey but a faint picture of that which is a part of us. And so his old disciples welcome with heartfelt gratitude every new image which may help better to fix for posterity the presence of our dear chief. The value of this new possession is greatly enhanced in that it comes to us through the thoughtful generosity of her who shares with him our lasting love and affection. Lady Osler, of her own initiative, has induced Mr. Sargent to make this replica of the portrait drawn by him for the College of Physicians in Philadelphia, and has sent it to us to-day. And so after all he is with us! We shall gain new inspiration from his counterfeit presence. Let us wait patiently in the hope that, four years hence, when the heavy clouds of the hour shall have rolled away, we may give him that welcome which our hearts hold for him to-day.

SCIENTIFIC ITEMS

We record with regret the deaths of Samuel Benedict Christy, professor of mining and metallurgy in the University of California; of Charles Martin Hall, the American electrochemist; of Professor N. C. Dunér, the Swedish astronomer; of Dr. Charles Périer, one of the most distinguished surgeons in France, and Dr. A. Van Geuchten, professor of anatomy and neuro-pathology at Louvain University.

Signor Guglielmo Marconi has been appointed a member of the Italian senate by King Victor Emmanuel.—It is one of the privileges of the Spanish Academia de Medicina that it is entitled to a seat in the senate. The member of the academy recently elected senator in this way is Dr. B. G. Alvarez, one of the editors of the *Pediatria Español*.—The gold medal of the Geographical Society of Chicago has been awarded to Colonel George W. Goethals. It will be presented to him at a dinner to be given by the society on January 23.

Several large bequests are reported this month for educational and public purposes. Dr. Charles M. Hall, known for his work on aluminum, bequeaths $3,000,000 to Oberlin College; Miss Grace Dodge, who during her lifetime was active in educational and charitable work, leaves $500,000 to Teachers College, Columbia University, $700,000 to Young Women's Christian Associations and other public bequests. Large bequests for public purposes are made by the will of Mrs. Mary Anna Palmer Draper, to whom in her lifetime science was greatly indebted for intelligent and generous support, including $150,000 to the Harvard College Observatory and $450,000 to the New York Public Library.

THE
POPULAR SCIENCE
MONTHLY.

MARCH, 1915

ASTRONOMY ON THE PACIFIC COAST

By Professor RUSSELL TRACY CRAWFORD

THIS subject brings instantly to the mind's eye the Lick Observatory on Mount Hamilton, and the Solar Observatory on Mount Wilson, as they are two of the greatest astronomical observatories in the world, and probably the best generally known of all. The one is an asset of the Pacific coast, probably accidentally, the other was placed there as a result of mature deliberation after thorough investigation of many locations. In addition to these two wonderful institutions there is in process of construction a third great observatory near Victoria, B. C., which, when completed, will contain the second largest reflecting telescope in the world. It is evident, therefore, that conditions on this coast are extremely favorable for developing the practical side of astronomy. On the other hand, the theoretical side of the subject is by no means to be lost sight of, as I shall point out.

In the early days before the erection of the Lick Observatory, the only astronomical work on the Pacific Coast was that done by the U. S. Coast and Geodetic Survey under the able direction of the late Professor George Davidson. This was not astronomical work as such, but merely the solving of such astronomical practical problems as were incident to the regular work of the survey. The first real scientific astronomical investigations came with the advent of the Lick Observatory.

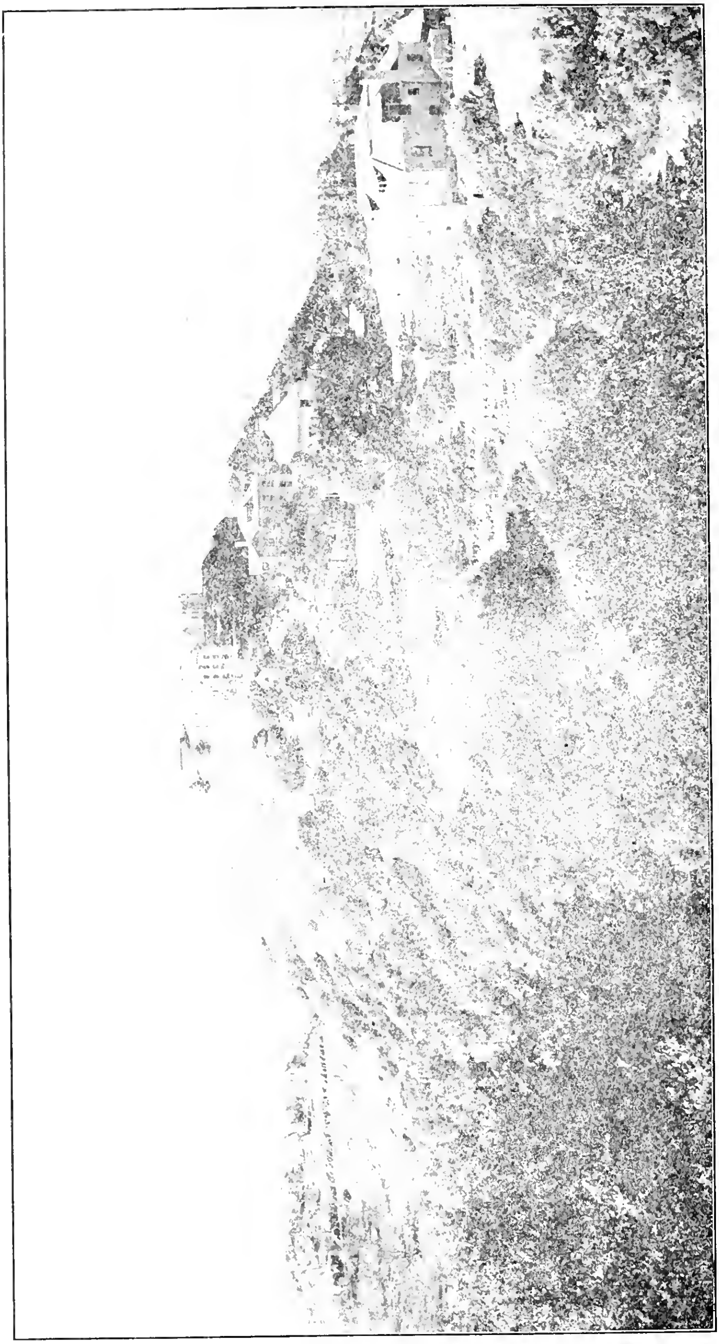
This institution is the gift of James Lick, a California pioneer, who had amassed a fortune of several million dollars.

> On July 16, 1874, he executed a deed of trust which devoted the entire sum to public purposes.

Among the provisions of the deed is one that directed the trustees

> to expend the sum of seven hundred thousand dollars for the purpose of constructing . . . a powerful telescope, superior to and more powerful than any telescope ever yet made, with all the machinery appertaining thereto. . . .

He left the trustees certain discretionary powers as to its location



Lick Observatory from the East.

with the proviso, however, that "the same must be located within the state of California."

Just why Lick provided for this telescope and observatory will probably never be known. While I can not recall my authority, I have a very distinct recollection of having heard it stated that the idea was first suggested to him and frequently urged upon him by Professor George Davidson. Concerning this point, however, the director of the Lick Observatory writes,[1]

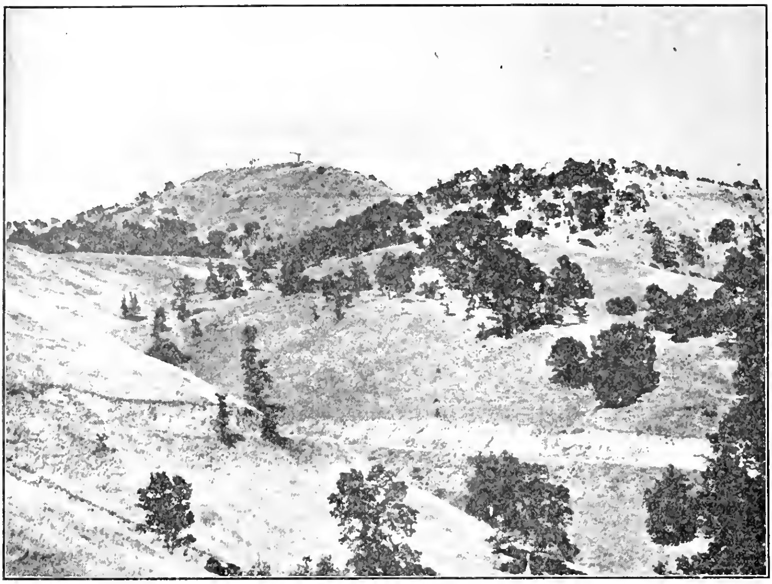
> The question, "What induced Lick to provide for a great telescope?" has never been satisfactorily answered; but there is no reason to doubt that he came to this determination without conscious suggestion from others.

After having several sites tested the trustees decided upon Mount Hamilton, California, as the best location for the observatory. Active work was begun in 1879, and the observatory was completed and ready for regular work in 1888. The plant cost all but $90,000 of the amount set aside for it. The observatory and this balance were turned over to the regents of the University of California by the trustees June 1, 1888; and since then it has been an integral part of the university.

The principal instruments of this observatory are the great 36-inch refractor, a 6-inch Repsold meridian circle, provided by the Lick Trust, and the 36¼-inch reflector, a gift from Edward Crossley, Esq., of England. Besides these there is a host of smaller instruments and auxiliary apparatus. I can not go into details here concerning the instruments, but I wish to mention one which has an important bearing upon the subject of this article. It is that the magnifying power of the great refractor may be made to be as much as 3,000 diameters. When one considers that everything in the line of sight of the telescope is magnified by this amount, it becomes evident that, to be efficient, the telescope must be located at a site where the atmosphere through which the line of sight passes is extremely steady, for any little atmospheric disturbance will be magnified to this amount and destroy what is called the "seeing," giving a poorly defined image of the star or object under observation. And it is principally on account of the splendid atmospheric conditions on the Pacific coast, especially on some of the moderately high mountains, which make *excellent* "seeing" possible that observational astronomy here has been able to make such tremendous strides.

For the efficient use of a great telescope its location must be in a region of great atmospheric calm, where the sky is clear and transparent, with little wind, and where the number of days and nights of a year during which such conditions do not exist is small. For some reason, the "seeing" conditions at Mount Hamilton during the day are not of the best; but at night excellent conditions are found on a large

[1] "A Brief Account of the Lick Observatory of the University of California," prepared by the Director of the Observatory. Fourth edition, 1914.



Lick Observatory from the West.

majority of the nights of a year, and many nights yield "seeing" that might be considered perfect. A glance at the illustrations showing the mountain as seen from the east and from the west will make it evident at once why these conditions obtain. With the exception of a saddle running eastward, the land slopes away rapidly from the summit down into deep valleys, so that there is but little opportunity for heat waves radiated from surrounding land to mount to the atmosphere above the observatory and create atmospheric disturbances. The mountain is not so very high (4,209 feet above mean sea level), but it is high enough to hold the observatory in an atmosphere free from dust, smoke and fog. Being near the ocean, fogs are very frequent at certain seasons over the valleys in this region. It is seldom, however, that they mount high enough to envelop the observatory. Many evenings and early mornings fog completely fills the surrounding valleys, so that the observatory seems to rest on an island in a vast sea of fog. Often peaks only a few hundred feet lower than Mount Hamilton are covered by the fog, yet the work with the great instruments is uninterrupted. The picture "Fog in the Valleys at Sunset" gives a better idea of this condition than I can describe. In such a location as this the 36-inch refractor can be used with its maximum power a large portion of the time. In less favorable localities even larger instruments would not be so efficient.

It is one thing to have an excellent plant, and it is another thing to have men skillful enough to operate such a plant effectively. A very proficient marksman can not do very much damage with a blunderbuss,

and one unskilled will not be able to produce any good results from the best modern artillery; but an expert behind a Krupp can produce a high percentage of effective hits. And so it is with the Lick Observatory. Not only is it a wonderful engine of science, but also it has been very fortunate in the astronomers who have operated it.

I can not here go into the details of all that has been done at the Lick Observatory, but the following extracts from "A Brief Account of the Lick Observatory of the University of California," prepared by the director of the observatory, 1914, give an idea of the principal things of general interest that have been accomplished in the quarter of a century of its existence:

1. To the four bright satellites of Jupiter discovered by Galileo in 1610, the Lick Observatory has added four satellites.

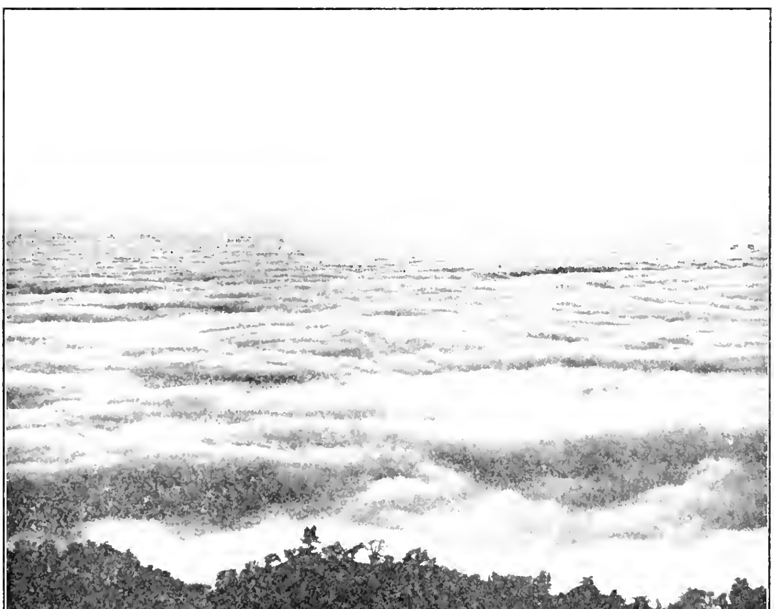
2. Twenty-nine comets have been discovered. Nineteen of these were unexpected, and ten were periodic comets whose return had been predicted.

3. The first great success in photographing comets and the Milky Way were made here.

4. About 4,400 double star systems have been discovered.

5. Irregularities in the motions of the first magnitude star *Procyon* had led the celebrated German astronomer Bessel, three quarters of a century ago, to predict that *Procyon* had a companion sun revolving around it. This companion was discovered with the Lick telescope.

6. Spectographic observations of stellar motions have shown that the solar system is traveling through space, with reference to the general stellar system, at a speed of about twelve miles per second.



Fog in the Valleys at Sunset, Mt. Hamilton.

7. The Mount Hamilton and Santiago[2] spectographic observations of stellar motions have shown that stars effectively young are traveling slowly, middle-aged stars more rapidly, and old stars more rapidly still; that is, that the velocities of the stars increase with their effective ages.

8. Observations have established that those nebulæ known as planetary nebulæ are traveling through space with average speeds even higher than the average speeds of the stars. It had previously been supposed that these nebulæ represented a stage of existence antecedent to the stellar age. The high velocities of these objects have created the opinion that they have more probably been formed from stars which have been overtaken by catastrophes, such as collisions with other celestial objects.

9. The North Pole Star was found to be a triple star, in 1899, by means of spectrographic observations. The first magnitude star *Capella* was discovered to consist of two stars revolving around their center of mass in 104.1 days, the two nearly equal components being inseparable in our largest telescopes.

10. In the same manner about 250 spectroscopic binary stars have been found at Mount Hamilton and Santiago.

11. A study of the orbits of spectroscopic binary stars has established that the component stars in a system whose spectrum indicates early age are relatively very close together, requiring very short periods of revolution, and that the orbits are nearly circular. In systems whose spectra show them to be of greater effective ages, the distances separating the components are successively greater, on the average, and their orbits are more eccentric. The observed facts on the subject are fully confirmative of existing mathematical theories of the evolution of double star systems.

12. The Crossley reflecting telescope established for the first time the tremendous advantage of this form of telescope in the photography of certain classes of celestial objects, such as nebulæ, star clusters, etc.

13. Before the Crossley reflector was in use about 10,000 nebulæ had been discovered at various observatories. A few dozens of these were known to be spiral in form. The Crossley photographs led to the discovery of many hundreds of additional nebulæ in the extremely small part of the sky covered by the photographs. It was a simple matter to calculate that certainly 120,000 and possibly half a million nebulæ await discovery whenever time can be spared for the Crossley reflector to undertake this work. These photographs led to the unexpected discovery that a majority of the nebulæ are of spiral form—undoubted evidence of their rotation.

14. The extensive series of photographs of the minor planet *Eros* and surrounding stars, with the Crossley reflector, led to a new and accurate determination of the distance from the earth to the sun.

15. Eight total solar eclipses have been successfully observed by expeditions whose expenses were defrayed by friends of the observatory.

16. It has been shown that the new stars appearing in recent years have been converted into nebulæ, and later, in many cases, into extremely faint stars of apparently normal condition.

17. Many thousands of extremely accurate positions of the stars have been secured with the meridian circle.

18. Very extensive observations of double stars, comets, planets, and satellites have been made.

19. A large number of orbits have been computed for visual double stars, spectroscopic binary stars, comets, and asteroids.

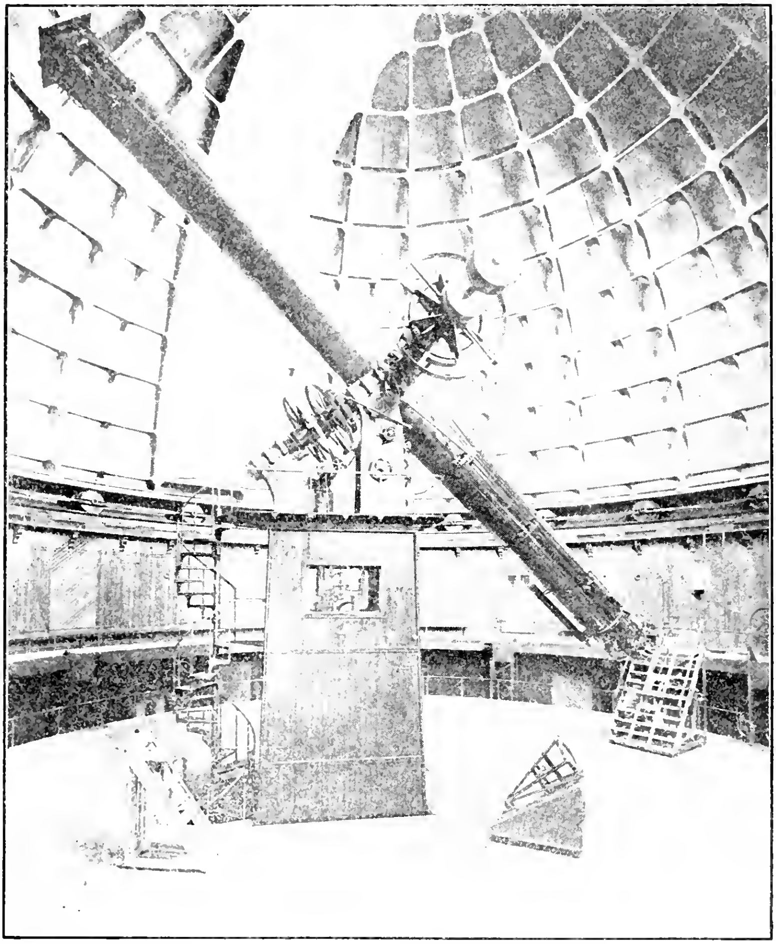
20. Extensive additions have been made to our knowledge of the spectra of nebulæ, comets, new stars, and stars of special interest.

[2] Santiago, Chile, is the location of the D. O. Mills Observatory, which is administered by the director of the Lick Observatory.

21. Important studies of the spectra of spiral nebulæ and star clusters have been inaugurated.

22. An atlas of the moon was made in the first year of the observatory's existence, on the basis of photographs obtained with the large telescope.

23. The motions of approach and recession of about 1,500 naked-eye stars, distributed over the entire sky, have been observed with the 36-inch refractor at Mount Hamilton and the D. O. Mills reflector at Santiago.



THE 36-INCH REFRACTOR OF THE LICK OBSERVATORY.

24. Spectroscopic observations at Mount Hamilton and on the summit of Mount Whitney have shown that the atmosphere of *Mars* is of low density, probably much less dense at the surface of *Mars* than the earth's atmosphere is at the summit of the highest peak in the Himalaya Mountains. These observations have established likewise that the quantity of water vapor in the atmosphere of *Mars* above, say, a square mile of its surface, must be very slight as compared with the quantity of water vapor in the earth's atmosphere above an equal area.

Mount Wilson Solar Observatory.

The wise economical policy of this observatory is to engage principally in those investigations which can not be carried on with smaller and less effective instruments. Much that could be done there is left to smaller institutions. The great instruments are used only for the problems that demand their great power. And these are quite sufficient to keep them in constant use.

Turning now to the Mount Wilson Solar Observatory we find a unique institution. As its name implies, it is an observatory erected primarily for the study of the sun.

In 1902, Dr. S. P. Langley addressed a communication to the Carnegie Institution recommending the establishment of an observatory at a very high altitude for the special purpose of measuring the solar radiation.

This recommendation resulted ultimately in the erection of the Solar Observatory by the Carnegie Institution by which it is supported. Various sites in Arizona and in southern California were tested, and the summit of Mount Wilson (nearly 6,000 feet above sea-level) near Pasadena in southern California was selected. In the choice of a site for this observatory excellent "seeing" conditions in day time as well as at night were of primary importance. Such conditions were found to exist on Mount Wilson.

For director of the observatory a very wise choice was made in Dr. George E. Hale. It is due principally to his genius and untiring efforts that this wonderful plant has been designed and brought to its present high state.

Dr. Hale points out that the term "solar observatory" is to be used in a broad sense,

since it is not intended to exclude from the program certain investigations of stars which are of fundamental importance in any general study of the problem of stellar evolution. For the sun is a star, comparable in almost every respect with many other stars in the heavens, and rendering possible, through an intimate knowledge of its own phenomena, the solution of some of the most puzzling questions in the general problem of stellar evolution. Conversely, however, the stars are suns, and if we would know the past and future conditions of the sun, we must examine into the physical condition of stars which represent earlier and later stages of development. It will be seen that there is ample ground for the inclusion in the equipment of a solar observatory of certain instruments especially designed for the study of stellar problems.

Such an observatory, whose primary object is "to apply new instruments and methods of research in a study of the physical elements of the problem of stellar evolution," must of necessity have as complementary parts of its equipment a physical laboratory and an adequate machine shop. These two parts have been supplied and are located in Pasadena. Here not only are smaller pieces of apparatus made and repaired, but also the enormous discs of glass for the 60-inch and the 100-inch reflectors have been figured and tested.

The instrumental equipment of the solar observatory is naturally

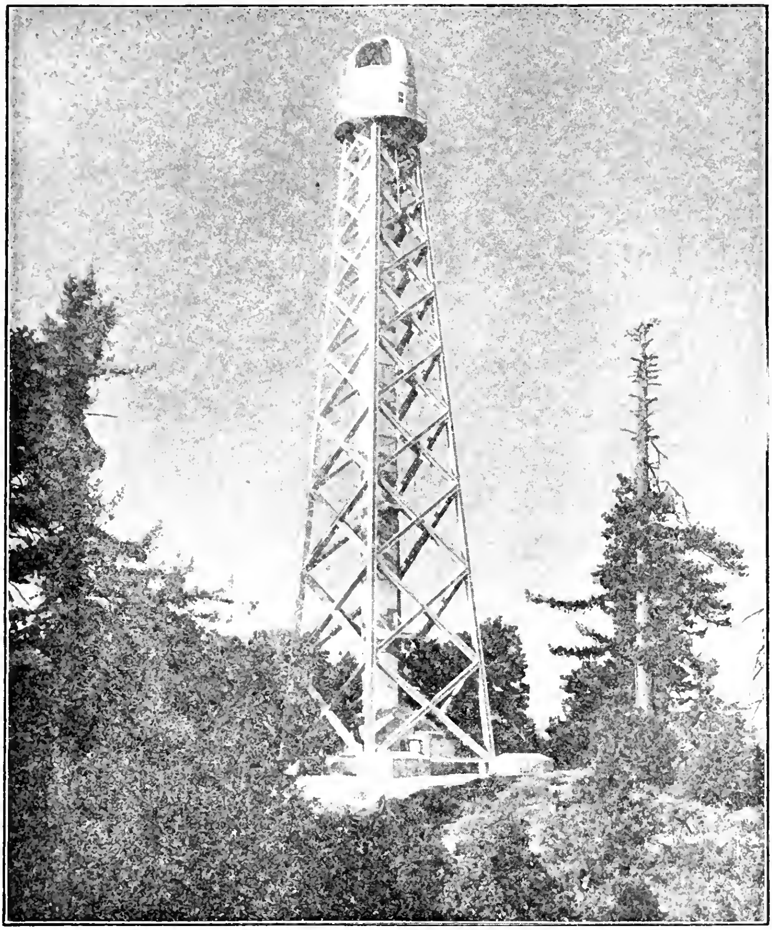
very complete. In addition to the numerous smaller pieces of apparatus there may be mentioned in particular the Snow telescope, the two tower telescopes, and the monster reflectors.

The Snow telescope consists of two 24-inch concave mirrors of different focal lengths (when either one is in use the other is easily put out of the way) mounted well above the ground in such a way as to throw the sun's rays horizontally under a louvre covering to the spectroscope or other apparatus, where they are analyzed. Soon after this instrument was in operation Dr. Hale conceived the idea of mounting the cœlostat at the top of a tower, and sending the rays vertically downward to the spectroscope so as "to avoid disturbance of definition caused by heated currents of air arising from the ground." He therefore had designed and erected a 65-foot tower for this purpose. This was very successful. Then desiring a greater focal length than could be obtained with this height, he had built a second tower 150 feet high. Under this tower a well was excavated to the depth of nearly 80 feet, thus providing for a possible focal length of about 230 feet. The 150-foot tower is of ingenious construction. It is a tower within a tower. The main structure which supports the cœlostat at the top is completely sheathed in an encasing tower which supports the dome, so that there is complete protection from the wind. When one looks at the tower he sees only the framework of the sheathing. This great tower telescope is a most efficient and satisfactory instrument.

There is no larger telescope in operation to-day than the 60-inch reflector, the reflecting surface of which was ground by Mr. Ritchey in the shop at Pasadena. The remarkable photographs of nebulæ that have been made with it speak loudly in praise of its efficiency. This instrument is soon to be supplanted in its proud position of size by the 100-inch reflector, the gift of Mr. J. D. Hooker, which is nearing completion. The figuring of the enormous block of glass has also been done by Mr. Ritchey. The present state of the building to hold this great reflector is shown in the accompanying picture. The completion of this, the largest telescope in the world, will undoubtedly mark an epoch in observational astronomy. Its light-gathering power will be nearly three times as great as that of the 60-inch, and more than seven times that of the Crossley reflector of the Lick Observatory which in its turn fifteen years ago marked an epoch. If "half a million nebulæ await discovery" with the Crossley, think of the possibilities awaiting this giant!

In the ten years of its existence the results of the investigations of the Mount Wilson Solar Observatory have been very numerous and most valuable. I have not space here even to enumerate them. Every annual report of the director contains a summary of the principal results of the year. The number of such results is noticed to increase from year to year. In the last Annual Report (1913) seventy-two results are summarized. Most of these are of such a technical nature that they are

of interest only to the scientist. Of the results of general interest I may mention the discovery of magnetic fields in sunspots; the fact that "the sun is a magnet, with magnetic poles at or near the poles of rotation"; "the polarity of the sun corresponds with that of the earth—a conclusion which may prove to have an important bearing on theories of terrestrial magnetism"; "the evidence that has been amassed in sup-

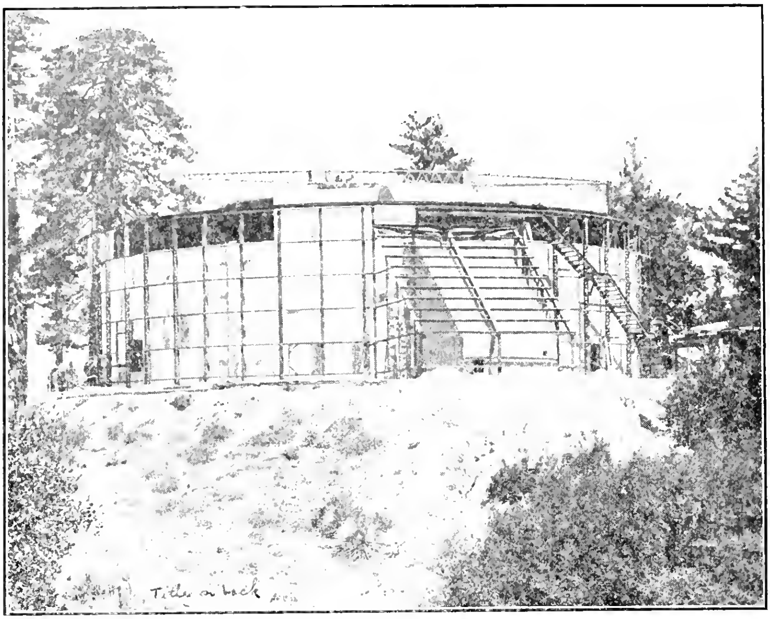


THE 150-FOOT TOWER, MT. WILSON SOLAR OBSERVATORY.

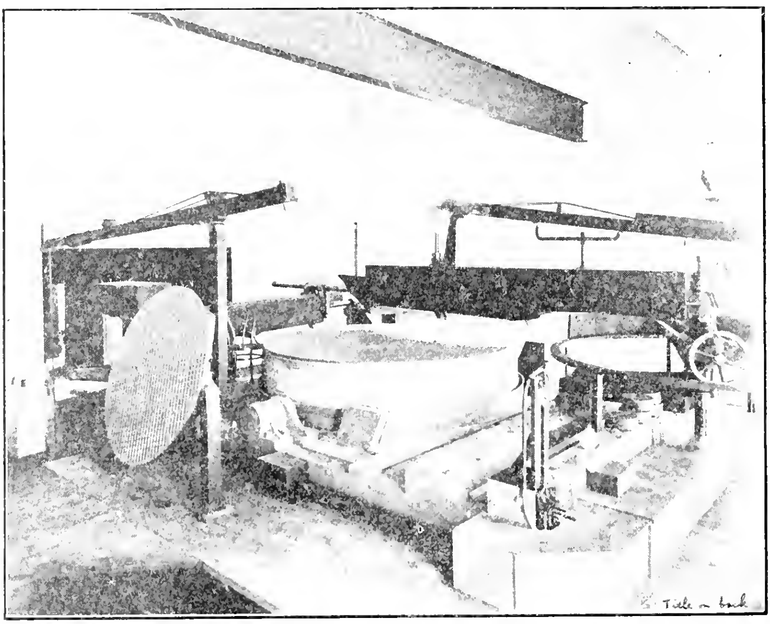
port of the view that light is absorbed in space." The last, as Dr. Hale points out

> not only offers an explanation of otherwise obscure phenomena, but promises to give what appears to be the only possible method of measuring the most profound depths of the universe.

The investigations of the solar observatory are carried on not only by the regular staff, but also by other scientists who are invited to make use of the wonderful equipment there.



PRESENT STATE OF BUILDING FOR HOUSING THE 100-INCH REFLECTOR, MOUNT WILSON SOLAR OBSERVATORY.



THE GLASS DISC FOR THE 100-INCH MIRROR, in the Pasadena Laboratory of the Mount Wilson Solar Observatory.

The Lick and the Mount Wilson Solar Observatories are the only ones at present on the Pacific coast whose energies are devoted wholly to investigations. A third will soon be in operation. This is to be an observatory eight miles north of Victoria, B. C., to house the 72-inch reflector of the Canadian government. Dr. Plaskett says:

> Word has been received from Paris that the disc for the mirror is ready for shipment and there is every prospect of the telescope being ready for erection next year.

This was written in June, 1914. A later report tells us that the disc has been received at Allegheny, and that work upon the mirror has been begun. When completed this will be the second largest reflector in the world.

In addition to these there are on the Pacific coast several small observatories connected with educational institutions whose principal use is to supplement by practical work the instruction in astronomy in these institutions. Among these may be mentioned the observatories of Pomona College, of Santa Clara College, Chabot Observatory of the Oakland High School (the Chabot Observatory is soon to be supplied with a 20-inch refractor), University of Washington, and the Students' Observatory of the University of California. Besides these there is a small government observatory, a branch of the U. S. Naval Observatory, located at the naval station on Mare Island, used principally for time service and the regulation of the chronometers of the ships of the Navy. Finally, there are a few small private observatories wherein some amateur astronomers delight to "follow the courses of the stars."

Theoretical as well as practical astronomy is well fostered on the Pacific coast. Its chief development is to be found in the Berkeley Astronomical Department of the University of California. Here has been organized a thorough school of astronomy, than which, according to the late Professor Simon Newcomb, there is none better. Not only is the science taught at Berkeley, but also theoretical investigations are continually being carried on.

It is only natural that in a region possessed of such institutions as I have mentioned there should be a considerable interest in astronomy among the people. This interest is manifested principally through an organization known as the Astronomical Society of the Pacific with headquarters in San Francisco. This society resulted from the interest taken by a group of amateur astronomers and photographers in the total eclipse of the sun visible in California, January 1, 1889. It has a membership of several hundred who are interested in a general way in the science of astronomy. In addition to its meetings the Society issues bi-monthly its Publications of the Astronomical Society of the Pacific. The Society has been given two funds the interest from which is to be devoted to giving certain medals. One of these is known as the

Donohue Comet Medal. One such medal is awarded to every discoverer of a new comet. The other is the Bruce Gold Medal, and is looked upon as one of the most important medals that can be awarded to an astronomer. It is awarded "for distinguished services to astronomy." The medal itself is a beautiful work of art, and is valuable both intrinsically and for what it symbolizes. The great value that astronomers attribute to this medal can be appreciated better when the manner of making the award is understood. The process is as follows: The directors of six observatories (Harvard, Yerkes, Lick, Berlin, Paris, and Greenwich) are each requested to nominate three men worthy to receive the medal in any given year. After these nominations are in it is usually found that six or seven names are presented to the directors of the Society from which then their choice for the medal *must* be made. If an award is made, therefore, it is to some one nominated by one or more (usually more) of the directors of six of the leading observatories of the world. There can be no doubt then that the recipient is justly entitled to this medal "for distinguished services to astronomy." That it is most highly prized by its recipients I quote from a typical letter of acceptance of the medal. The medallist writes, "I regard this distinction as the highest an astronomer can receive. . . ."

The results of the investigations at the Lick Observatory are issued in the Bulletins of the Lick Observatory for short articles, and in the Publications of the Lick Observatory (Volume XII. just issued) for the more extended work. Results from the Berkeley astronomical department are also issued in the Bulletins of the Lick Observatory, and one volume (VII.) of the Publications of the Lick Observatory is devoted to its investigations.

The Contributions from the Solar Observatory, Mount Wilson, California, issued by the Carnegie Institution of Washington, give to the world the results of the investigations carried on at the observatory on Mount Wilson and in the laboratories in Pasadena.

The Publications of the Astronomical Society of the Pacific I have already mentioned. The list of astronomical publications on the Pacific coast is made complete, I think, when I mention finally the Publication of the Astronomical Society of Pomona College, an interesting quarterly popular magazine issued by the astronomical students of Pomona College.

In preparing this account of astronomy on the Pacific coast I have drawn freely from "A Brief Account of the Lick Observatory" (fourth edition), and from the annual reports of the director of the Mount Wilson Solar Observatory. In conclusion I wish to express my thanks to the directors of these two observatories for their kindness in providing the illustrations.

THE BIOLOGICAL LABORATORIES OF THE PACIFIC COAST

By Professor WM. E. RITTER

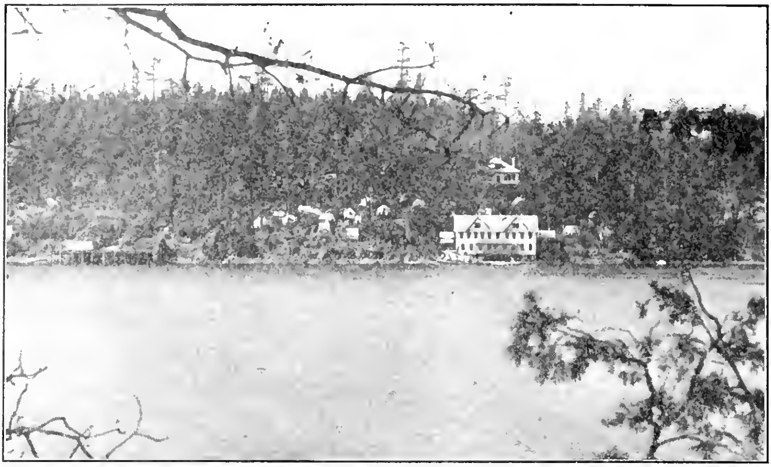
THE study of marine botany and zoology has gained a foothold on the Pacific coast of the United States in the brief period during which biology has been institutionally naturalized in this part of the world, that promises well for the future.

Seaside laboratories have been established at three main centers of population: at Puget Sound, in central California, and in southern California. At the extreme north the University of Washington, in cooperation with several other institutions, has a laboratory at Friday Harbor on San Juan Island. In central California the Timothy Hopkins Laboratory on Monterey Bay, belonging to the Leland Stanford Junior University, has now been in operation for twenty-three years; and near by is the Herzstein Laboratory owned by the University of California. On the coast of southern California are the Scripps Institution for Biological Research at La Jolla, near San Diego, securely founded because permanently endowed, and in the vicinity of Los Angeles laboratories at Venice and Laguna Beach are manfully striving toward permanency. The Scripps Institution is a research department of the University of California. The laboratory at Venice is being fostered by the University of Southern California and that at Laguna Beach by Pomona College.

With this bird's-eye view of what the country's long western sea frontage presents in the way of effort to turn to intellectual account the riches of life of this part of the Pacific ocean, we may proceed to a somewhat closer look at what is being done.

A student of marine life who has considered the geography of Puget Sound even from afar, does not need to be told that it is a great, richly stocked aquarium of both animals and plants. Almost completely landlocked though sufficiently open at both ends to enable the water to flow through it with each run of tides, beset with innumerable irregular islands, and rock-shored everywhere, a piece of the sea could hardly be more ideally circumstanced for all kinds of organisms adapted to such conditions. For several decades the prodigality of life in the Sound has aroused the enthusiasm of naturalists, resident and visiting.

Credit for the first efforts to create a laboratory for making use of this wealth of life is due to Professor Trevor Kincaid, of the University of Washington. After several years of preliminary collecting and reconnoitering by Professor Kincaid and his students, Friday Harbor was selected in 1903 as, on the whole, the most favorable place for a per-



Puget Sound Marine Station, at Friday Harbor, San Juan Island, Washington.

manent laboratory. This salmon-cannery hamlet of a few hundred people situated on the eastern side of the large, partly agricultural San Juan island, is distant from Seattle about four or five hours' run for the small steamers which constitute the transportation system of the islands of the Sound. That the natural conditions of this location are good for the kind of work which the laboratory aims to do, there can be no doubt. The distance from the mainland ports is something of an inconvenience, but the isolation would seem to be a perpetual security against contamination of the water by a large city and much shipping; and this is a consideration of great importance for such a laboratory.

For a number of years the station went through the experience familiar to such undertakings, that of playing cuckoo so far as housing is concerned. In this instance the alien home was an abandoned salmon cannery.

But the persistence and enthusiasm of Professor Kincaid and his colleagues finally bore fruit to the extent of a four-acre piece of land, the gift of Captain Newhall, of Friday Harbor, as a permanent site; a new laboratory building about seventy-five by thirty feet in floor area, two stories high; a mess house about forty feet square; and forty-five platform tents for living quarters. The buildings were provided by the University of Washington on money appropriated by the state legislature. The laboratory proper situated at the very water's edge, indeed, partly over the water on piles, is at the foot of a beautiful wooded bank that reaches up one hundred feet or more at an angle of full forty-five degrees from the back door of the building. The first floor of the laboratory is mostly one large room in which are the salt-water aquaria and facilities for experimental work of various sorts. On the second floor are nine private workrooms and a large room thirty

feet by thirty feet which is used for various laboratory and other purposes. Besides the work space in the laboratory building a laboratory for botanical study has been fitted up in the basement of the commons building.

The station owns a fleet of a dozen row boats, but as yet no power boat, dependence been placed so far on hired boats for the heavier bottom collecting.

This station stands alone among its kind on the Pacific coast in aiming to be intercollegiate in constitution and maintenance. While, as already indicated, the "plant" has been furnished by the state, and is owned by the university; and while the state is at present supplying nearly all the maintenance funds, about $3,000 a year, a system of coöperating institutions is nevertheless being worked out. At present the Universities of Kansas and Oregon and the Washington State Normal School at Billingham are, I believe, the only institutions in the partnership, but the plan is being earnestly pushed and other schools and colleges, notably Reed College of Portland, Oregon, seem likely to enter.

So far the laboratory has not aimed at much beyond formal instruction and general information-getting on the part of those who assemble there; and sessions have been restricted to a few weeks in the summer. The session of 1913 saw an attendance of about one hundred teachers and students, these being drawn from a wide area of the northwestern United States. This considerable number may be taken to indicate the reality of the demand for opportunity for this kind of study in this region. No doubt this demand will increase and will soon expand to include advanced specialized studies and genuine investigation as well as elementary instruction and general information. Since the beginning of the session of 1914 Professor T. C. Frye, of the department of botany of the University of Washington, has been director of the station, Professor Kincaid having turned his interest and efforts in other directions.

Traveling down the coast from Puget Sound to central California, one finds the Timothy Hopkins laboratory at Pacific Grove on Monterey Bay belonging to the Leland Stanford Junior University. This is the pioneer among the marine laboratories on the Pacific coast, its life being practically coexistent with that of the university of which it is a part. It began its work in 1892, only about a year after the university opened its doors. It is also the most commodiously housed of the western stations, and, in keeping with its greater age and size, has furnished facilities to more biologists than any of the other Pacific coast laboratories.

About eighty students can be accommodated in the station's two buildings. There are four general laboratories, one lecture room, and

seventeen private laboratories for investigators. The buildings, of wood, are both two stories high, well lighted and amply supplied with running water, both salt and fresh. According to the directors, about seventy-five investigators have made use of the laboratory since its foundation and something like six hundred and fifty students of various grades have received instruction. Regular class instruction is given each summer by university professors from the departments of zoology, botany and physiology. Although the buildings are not formally open during the rest of the year, investigators are usually able by special arrangement to get the use of the laboratories at almost any time.

The laboratory was a gift of Timothy Hopkins, of Menlo Park, Calif., but is dependent on the university for maintenance funds, library, and equipment. Students who receive class instruction pay fees, the money derived from this source being applied to the running expenses of the institution.

Professors C. H. Gilbert and O. P. Jenkins, of the departments of zoology and physiology, respectively, have been from the beginning joint directors of the laboratory, but the courses of instruction have been mostly given in later years by the younger men of the university, Professors Harold Heath, F. M. McFarland and W. B. Price having been especially faithful and efficient in this capacity.

Pacific Grove is an exceedingly advantageous location for a marine station, particularly one with the aims which the Hopkins laboratory set for itself; namely, those of providing facilities for investigations on littoral animals and plants and those inhabiting the bottom in relatively shallow waters; and of giving instruction to elementary students.

So far as the writer's somewhat extensive observations on the Pacific littoral of North America has gone, no other point on the whole coast, with the possible exception of Yakutat Bay in southeastern Alaska, has a rocky shore fauna and flora of greater luxuriance, whether as to individuals or species, than has the southern shore of Monterey Bay. This richness of life, taken along with the accessibility of the locality from a populous center, and the all-year-round congeniality of the climate, has made the Hopkins laboratory an important factor in the promotion of biological science in this part of the country. It is greatly to be hoped that at no distant day the laboratory will become possessed of sufficient funds to enable it to be fully prepared to receive investigators and students at any time of the year, and not be obliged to restrict its activities so largely to the summer months.

The Herzstein laboratory, also at Pacific Grove, is quite different in aim and scope of activities from the Hopkins. It was a gift to the department of physiology of the University of California by Dr. Morris Herzstein, of San Francisco, the primary purpose of which was to provide a sea-side working place where Professor Jacques Loeb could prosecute certain of his investigations.

In keeping with the relatively simple technic of the studies which have made this biologist famous, the Herzstein laboratory is small and inexpensive. It is a plain, one-story wooden building, about forty-five feet square, divided into three fairly good-sized rooms, two small store rooms and a dark room. It is provided with an alternating electric current, and running fresh water, but not with gas or salt water. The small quantities of sea water needed are brought to the laboratory from the nearby sea by hand. A good supply of glassware for experimentation on simple animals is always on hand.

As already indicated, the laboratory is operated in close connection, so far as research is concerned, with the department of physiology at Berkeley. No provision is made or is hardly possible for formal instruction or for any considerable number of investigators, or for much range of investigation.

At present Professor S. S. Maxwell, as head of the department of physiology, also has charge of the laboratory. Professor Loeb's use of it has not ceased, although he has severed his connection with the University of California. He has spent considerable time at Pacific Grove during the last two years.

Going on down the coast to southern California, the undertakings at Venice and Laguna Beach must first be noticed in following the geographical order of treatment. Although, as intimated in the opening paragraph, these have not attained a strong and permanent existence, they have been useful as adjuncts to the teaching facilities of the colleges to which they belong, the University of Southern California, and Pomona College. The Venice Station possesses a power launch of sufficient size and equipment to make possible a good amount of collecting at sea. The director of the station is Albert B. Ulrey, professor of zoology in the University of Southern California.

The suggestion may be ventured here that the California coast south of Point Conception ought to have one good teaching sea-side laboratory which should have the support of all the schools and colleges in the south. We biologists of the southwest must, I think, allow that we are aspiring less wisely than are our colleagues of the northwest in the very important matter of promoting sea-side studies by young men and women.

The Scripps Institution for Biological Research being situated at the extreme southern end of the Pacific coast line of the United States must accept last place in this survey.

A somewhat full account of this station was published by the writer in 1912,[1] and the accessibility of this makes an extended statement here superfluous.

[1] "The Marine Biological Station of San Diego, Its History, Present Conditions, Achievements and Aims," Univ. of Calif. Publ. in Zool., Vol. 9, No. 4, March 9, 1912, pp. 137–248.

Though privately founded and for some time without organic connection with any other institution, its property and endowment were deeded to the regents of the University of California in 1911, thus making it a department of the university.

The main elements in its physical being are 177 acres of land with a half mile of ocean front in the city of San Diego about two miles north of the suburb of La Jolla; a fireproof reinforced concrete laboratory building 47 by 74 feet, two stories high; a 20,000 gallon concrete tank for sea water with tank house; thirteen cottage residences, one of which is a commodious two-story structure; one carefully planned and well-built animal house for experimental breeding; and an eighteen-ton motor boat, the *Alexander Agassiz,* equipped for biologic and oceanographic work at sea.

The laboratory contains twelve individual research rooms, six of which are furnished with aquaria constructed of concrete, iron and plate glass. There is also a general aquarium room with concrete tanks and glass aquaria.

A room 40 by 32 feet on the second floor contains a well-displayed collection of the marine life of the San Diego region. On the first floor in a combined collection and reagent room are arranged several thousand bottles of research collections, chiefly of pelagic organisms.

The library, consisting of about 3,500 bound volumes and a much larger number of pamphlets, occupies three rooms on the second floor, one of which serves as a journal and reading room. The books are fully classified, catalogued and arranged, and as the number is increasing rapidly the library is becoming a fairly good one for the kinds of investigation prosecuted by the institution. The university library at Berkeley still has to be called on, however, for many works, particularly when studies which fall outside the program of the institution are being carried on.

At present the institution has an annual income of about $20,000, $10,500 of which come from the Scripps endowment, $7,500 from the state of California, and the balance from miscellaneous sources, chiefly rentals.

The staff consists of four resident investigators, three of whom are biologists and one an oceanographer; a business manager who acts also as master of the *Agassiz;* a scientific secretary who serves likewise as assistant librarian; an engineer and keeper for the *Agassiz;* and a helper for the buildings and grounds. In addition, there is a non-resident contingent of the research staff consisting at present of four biologists. These are able by reason of their vocations to be in La Jolla only at irregular intervals and for short periods, but are regularly engaged upon the institution's program. They receive fixed compensations for their work.

The brief statement to be here made about the policy of this institution will be facilitated and possibly rendered more interesting by putting it in the form of a trenchant comparison between the two exclusively research stations of the Pacific coast; the Herzstein laboratory at Pacific Grove and the Scripps Institution.

For full two thousand years there have been among the inquiring two conceptions or faiths about the nature of the world, particularly the living part of it, that stand over against each other with a sharpness and apparently irreconcilable antagonism which, seen in their fullness, are highly poetic as well as profoundly scientific. These two conceptions flow from the university experience of the unity, on the one hand, and the diversity, on the other, of nature. Because of the first some men have conceived that at its core nature is One and Simple; and with an irresistible faith they have sought to penetrate to the single essence or substance held by this philosopher to be Spirit, by that Matter, the grasping of which should constitute the discovery of the great mystery of existence.

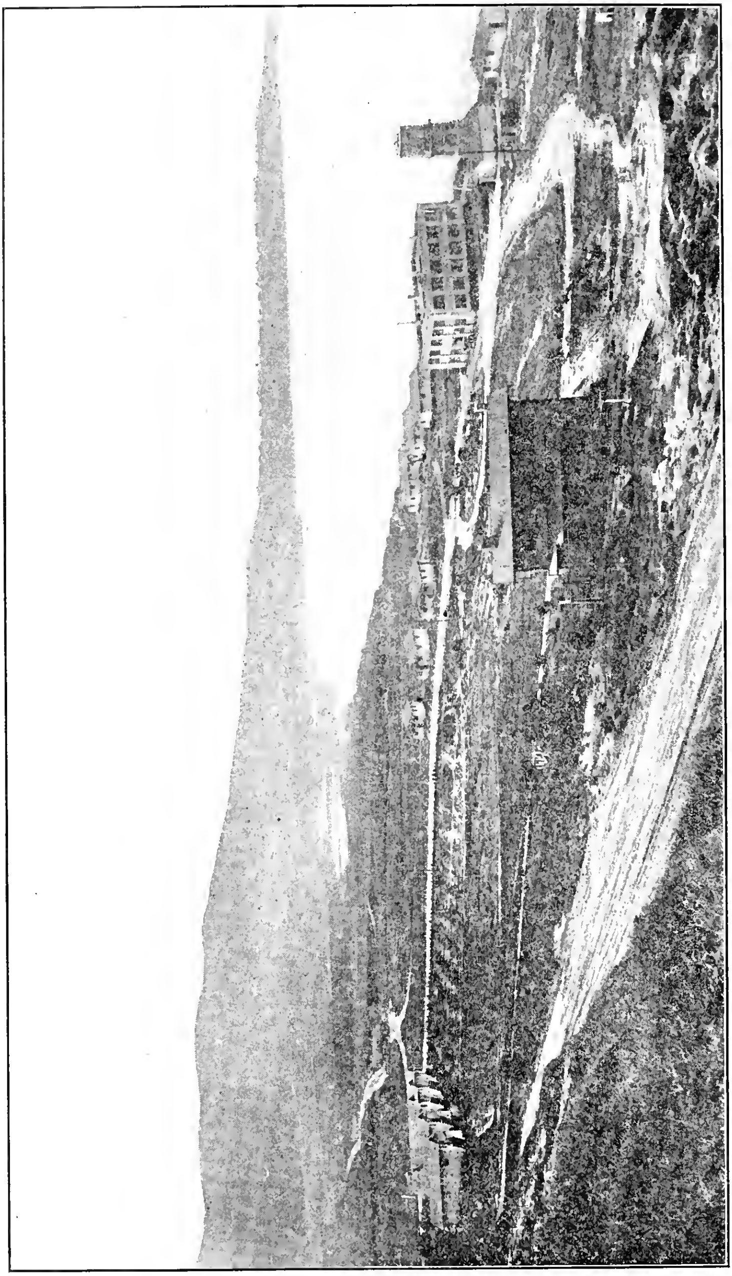
This kind of faith has found no finer expression in the modern era of all-pervading scientific analysis than in Tennyson's

> Flower in the crannied wall,
> I pluck you out of the crannies;—
> Hold you here, root and all, in my hand,
> Little flower—but if I could understand
> What you are, root and all, and all in all
> I should know what God and man is.

The distinguished scientist whose investigations the Herzstein laboratory was built primarily to further would probably agree that were his ultimate biological ideas and aims to be expressed in the poet's way, these lines would need as little alteration as any that could be found. He might wish to have the first line so altered as to give the flower's place to the sea urchin; and would probably want "God" replaced by "Mechanism" or some term which disguises its anthropomorphism as effectually. But the great basal idea ". . . if I could understand What you are . . . all in all, I should know what God and man is," would presumably need no alteration.

And why should not devout chemico-physical biologist and devout theist alike have each his unfaltering faith in substance, One or at most very few, All-pervasive, All-potent, Eternal? For has not each in his own sphere and his own way discovered to the deepest depths of his nature a few mighty realities underneath the vast, bewildering maze of phenomena?

No one can look upon the simple laboratory under the pine trees at Pacific Grove and contemplate the idea for which it stands without seeing true grandeur in its simplicity.



THE SCRIPPS INSTITUTION FOR BIOLOGICAL RESEARCH, at La Jolla, California; looking southwest across Long Beach to La Jolla.

But is the oneness of the world with its demonstrably underlying few substances and forces, whether these be held to be material or spiritual, more real than the diversity of it? Surely it is not so far as the every-day lives of every-day people are concerned. And the view that science is common sense refined and systematized withstands all objection. The fisherman's Albacore endures whatever test of reality may be applied to the biologist's sea urchin eggs or anything contained in them. It is impossible to define any given specimen of living substance so as to ascribe to it ultimateness without ascribing ultimateness to the living animal itself to which the specimen pertains if the same rules of defining be adhered to throughout. But if every part of the living world is as real and as ultimate as any other part, it is futile to expect to fully understand some portions of it by knowing other portions of it. The theory that any amount of understanding, even complete understanding, of a flower or a sea urchin would give complete understanding of man, to say nothing of God, is contrary to the fundamental nature of things and of knowledge. Nor, speaking chemico-physically, can any amount of understanding of the substances of which an organism is composed give complete understanding of the organism itself.

Vastly contributory to the understanding of organic beings as are chemico-physical investigations upon them, indeed impossible though it is to gain exhaustive knowledge of them in any aspect of their lives without such investigations, every truly vital chemico-physical problem of organisms is two phased: how do the chemico-physical attributes of the constituent substances act upon and so explain the organisms; and what particular structures and activities are the chemical substances caused to manifest by being constituents of and used by the particular organisms?

And so it is revealed that the familiar dictum "all life is one" must not be understood to mean that living nature has *only one life;* but rather that there is some thing *in common* among all the myriad things that live, namely, the half dozen, less or more, chemical simples now known to compose a living being. The diversities of living nature are, consequently, as "ultimate problems" as are its uniformities; and the biological institution which should set for its goal final solution of the problems of the organic world would be vast and complex and costly beyond any thing yet created or likely to be.

The administrative body of a research foundation in biology which should so understand biology would always have before it this compound question: what particular subject or group of related subjects at this particular time, in this particular locality, and under existing limitations of resources would best be investigated?

The Scripps Institution conceives its purposes in this way, at least while its present director stands as spokesman of its purposes. Just

now its small resources are being devoted to certain aspects of the mode of life of organisms in nature; to the nature and relationships of natural races; and to the influence of natural environments upon organisms, particularly as to the heritability of such influences. No other subjects are, in the belief of the management, of greater moment to present-day biology, and various circumstances make their study by the institution peculiarly practicable. But the managing board have no delusions as to the uniquely "burning" character of the questions under investigation, or as to its having reached the threshold of the Ultimate Mystery of Life and Death. Its profound belief in the importance of biologic truth to the welfare of humankind is of such sort that it knows that many other problems being studied by many other men and other institutions are no less vital than those engaging its efforts; and that problems of to-morrow, next year, next decade, next century, while different from those of to-day, will be no less numerous and no less insistent than those of to-day. It holds every item of positive knowledge of the living world essential to the scientific interpretation of that world; that such interpretation alone can beget a right attitude toward that world; and that the high level of man's development which we call civilization is wholly dependent upon a right attitude on the part of the largest number possible of the community toward all things that live.

THE LAST WILD TRIBE OF CALIFORNIA

By Professor T. T. WATERMAN

IN the fall of 1908 some attention was aroused in the press by a story to the effect that hunters had encountered in the state of California a tribe of Indians who were still in the stone age. The idea of a "wild" tribe in a thickly settled region like California was so novel that it served to awaken a very wide interest. The Indians themselves, however, had meanwhile vanished. Some three years later an individual who had all the appearance of belonging to this group was apprehended in northern California. He was put in jail, and a few days later turned over to the university. Since then he has been received everywhere as the last survivor of his tribe. The whole series of incidents deserves some explanation. I think it ought to be said at the outset that the story as given in the papers of that period is quite true. The individual captured in 1911 was a surviving member of a stone-age tribe. He is still alive and well at the university; and he has given from time to time extremely interesting accounts of the history of his people.

I should like to explain first of all the rather unusual career of this tribe, and how they happened to remain "wild." The occupation of California by the whites is usually pictured as a peaceful transaction. We hear little of Indian wars in connection with this state. The California tribes pursued, as it happened, a more or less settled mode of life. Being non-migratory, they were peculiarly open to attack and reprisal for any resistance they could have offered to the white invasion. The influx of whites moreover was on the whole so sudden and overwhelming that those Indian disturbances which did occur were soon forgotten. It is quite possible that if California had been settled one family at a time as New England was, "massacres" and "wars" would have occurred that would have rung down the ages like the wars waged by the Indians on the Colonies. If there had been a long course of conflicts, our California tribes might have developed a name for ferocity like that enjoyed by the Mohawk, or the Apache. As a matter of fact, the white occupation here was accomplished by violence and bloodshed, and through armed conflict with the natives far and wide. The U. S. Army records show almost as many movements of troops against the Indians as occurred in any other area of the same extent. The whole period of "occupation" was so short, however, that Indian troubles for the most part were soon things of the past.

So much for the general situation in California. In the wild and rugged part of the state, Indian resistance lasted for a long time. One such area was west of the Sacramento in the Siskiyou region, along the upper waters of the Trinity and Eel rivers. "Bad" Indians used to frequent the wilds in this part of the state long after the tribal organizations had broken down. Such Indians caused some little trouble to enterprising settlers in the hills. A region where the Indian opposition was still more spirited and where Indian disturbances dragged out still longer was in northeastern California. Here the Pitt River Indians, and later the Modocs, put up a number of very spirited contests before knuckling under. The whites, on the whole, were very bitter towards "wild" Indians, even when harmless, and blamed them for everything, from the occurrence of freshets to the presence of potato-bugs.

It must of course be recognized that the occupation of California by the whites was inevitable. The Indians had to be dispossessed to make room for the new order. The white occupation, however, was not only inevitable, it was relentless. The methods used are not a thing of which we can be proud. The whites, for example, introduced into California, where it was unknown prior to their coming, the practise of scalping. It was very much the fashion in the early days for white settlers and miners to carry on Indian wars individually and informally. The line between their actions and plain murder is rather hard to draw. Many of the white loafers and irresponsibles that "bummed" around the frontier settlements used to preach openly a doctrine of "exterminating" the Indians. A very considerable proportion of our "Indian fighters" in this state deserved, in strict justice, to be hung. It may throw some light in general on the nature and methods of these "wars" to state that there existed in California, long after the close of the civil war, a lively traffic in Indian slaves. White administration of Indian affairs in the more easterly states impresses one most by its hopeless stupidity. The history of whites and Indians in California impresses one rather with a sense of the white man's ruthlessness.

The Yahi Tribe

In the northeastern part of the Sacramento valley there lived a nation of Indians who were early driven into a vigorous hostility to the whites. They had already, from their friction with other tribes, developed some adeptness in raiding and thieving, and in a sort of guerilla warfare. Their northern branch, the so-called Nozi, after a time capitulated, and became hangers-on of civilization. The southern branch of the stock, calling themselves simply Yahi, or "people," and inhabiting a stretch of country immediately east of the Sacramento, kept the whites in a state of uncertainty for a considerably longer time.

There is one relatively small region in particular which came to be specially identified with this small group of Indians. That is the country immediately about Mill Creek. East of the Sacramento, along the waters of Antelope Creek, Mill Creek, Dry Creek, Deer Creek and Butte Creek, the country is covered with a cap of lava. The original source of this lava was, I believe, the mountain which has recently been attracting so much attention to itself—Lassen Butte. The elevation of the region frequented by hostile Indians is not great (it all lies below the level of the pine forest) but the streams have cut in the lava a large number of rough cañons and gullies. Near as it is to the level valley, the country is extremely rugged. Cliffs, crags, and sudden promontories are frequent, and there are great numbers of caves. While the settlement and cultivation of the valley has gone forward very rapidly, this region in the foothills has remained almost untouched. To-day this "lava" country is the resort of animals (and to a certain extent, of plants) which are becoming extinct elsewhere. In this small region in north central California the Yahi made a determined stand against civilization.

In the course of their life in these cañons they developed an intense hatred and fear of the whites. They came to be hunted very much like wild animals. Accordingly they developed peculiar habits of visiting the valley in sudden forays, escaping instantly to the hills afterwards. These sudden visitations, often resulting in the loss of life as well as property, were a genuine bugbear to homesteaders. On the other hand, the Indians were on their part often harried by famine. Pressure from the whites prevented them from making full use of the natural foods the country afforded. Even acorn-gathering was for them a dangerous pursuit, since it gave opportunity for white attack. Their natural means of subsistence therefore seem to have been almost entirely cut off. An idea of their desperation may be gathered from the fact that on at least one occasion when they attacked the whites and were chased, their plunder consisted of a mule-load of vegetables. In other words, they took the field and risked their lives for the sake of a few squashes and some ears of corn.

It has always been supposed that remnants of several tribes made up these Mill Creek renegades. From what we have recently learned, it seems very unlikely that there was more than one tribe involved. In the first place, the only member of this hostile group who has ever been questioned, expresses the liveliest dislike of all other tribes. He seems, and always has seemed, more ready to make friends with the whites themselves, than with the neighboring groups of Indians. In the second place, all the other Indian tribes of the region profess the liveliest horror of the Yahi. This awe extends even to the country to-day which the Yahi frequented. Even the Yahi and the Nozi, though they spoke

dialects of one language (the so-called Yana) express the most unrelenting hostility for each other. In other words, the Indians who lurked about in the Mill Creek hills for several decades after the settlement of the valley, were probably the remnant of a comparatively pure group, since there was little likelihood of intermixture.

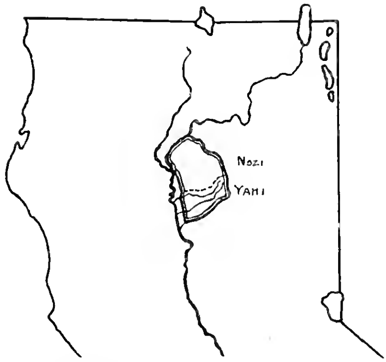
The Mill Creek "War"

Between the years 1850 and 1865 this group was more or less under observation by the government. Rumors of battle, murder and sudden death came frequently from this region to the central authorities in San Francisco and Sacramento. On one or two occasions attempts were made by the War Department to apply the universal remedy for Indian troubles—removal to a reservation. Details concerning the movement of troops and some very heated correspondence relative to this tribe may be found in the government records (War Records, Volume 50). The names of some very distinguished Californians appear in this connection. I recall especially Governor Stanford, and General Albert Sydney Johnston. The only book I know of which deals exclusively with events in the Yahi region is a small but vivid volume written by R. A. Anderson, an actor in the events, and sometime sheriff of Butte County ("Fighting the Mill Creeks," Chico, Cal., 1909). This little work checks up with the records of the War Department. The "war" with this small tribe seems to be quite overlooked in the histories of California. There is no mention of it in either Bancroft or Hittell. The reason probably is that it was very much like what had happened, or was happening, on a larger scale elsewhere. The War Department correspondence is quite full for the period covered.

The end of the Mill Creek "war" was unusual and to some extent tragic. A party of armed whites, acting without other authority than resentment and an inborn savagery, surprised the tribe on the upper waters of Mill Creek in 1865. Their effort apparently was to wipe out this Indian group on the spot. On the admission of men who took part in the action, fire was opened on the defenceless Indians in the early morning, and an uncertain number of them, men, women and children, shot down. A few, not more than three or four, perhaps, escaped into the brush and got clear. The Mill Creek tribe as a tribe disappeared from history at this time. With one or two possible exceptions, nothing was seen of it again for over thirty-five years.

Hidden Life of the Survivors

The survivors who escaped these executive measures of 1865 were too few in number to resume their old mode of life. They were, on the other hand, so small a party that they succeeded in hiding away. Little by little they emerged from their hiding places and took up again the



Map of Northern California showing the location of the Yahi and Nozi peoples.

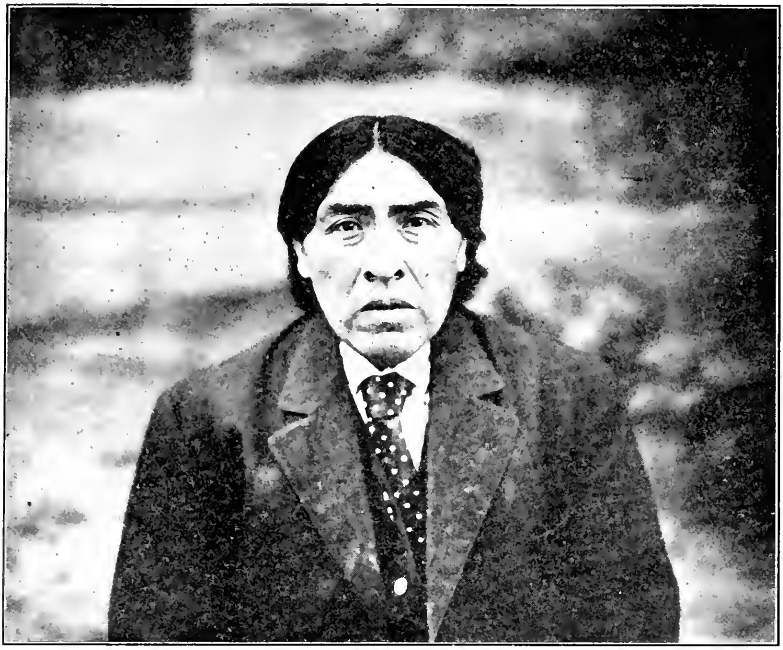
procuring of food by hunting and fishing. They did not, however, allow themselves to be seen. They undoubtedly expected annihilation to follow on discovery, and probably there was sound judgment behind this belief. The almost entire absence of information concerning them proves that they took to the wildest places, and stayed there. All that we positively know about them is that they disappeared in 1865, but were still alive in 1908. Under the circumstances, they must have remained "primitive." Only the primitive mode of life was open to them. They were primitive when they went into retirement, and it was their salvation. When seen again in 1908 they still used the bow and arrow and other aboriginal appliances, and were absolutely unfamiliar with the usages of civilization. Their avoidance of observation of any kind left them as isolated as if they had been literally on another continent.

Our information concerning them during this period is very scanty.

Deer Creek Canon. The last refuge of the "Yahi" tribe.

The existence of "wild" Indians in this part of the world was known, or at least believed in, in many quarters, in spite of definite information. Thus Stephen Powers in his classical "Tribes of California" (U. S. Department of the Interior, Contributions to North American Ethnology, Vol. 3) says, without giving names, that five of this tribe, two men, two women, and a boy, were seen in 1870. This group gave from time to time further proof of their existence by their habit of secretly taking food from distant and lonely mountain cabins. It is a settled fact, that this fugitive remnant of a tribe did fairly well with their primitive mode of life, except in the late winter and early spring. By that time their stores were usually exhausted and the salmon had not yet begun to run in the streams. Their fear of the whites forbade any change of home or habitation in search of food. The only course possible, aside from quiet starvation, was to seek out some white man's cabin somewhere in the hills, help themselves to food as quickly as possible, and carry it back to their lurking places. This they seem to have done on several occasions almost every year. To this we probably owe the fact that the group managed to remain alive. This robbing of cabins could not, of course, pass unnoticed. Such cabins as exist in these hills are mere temporary shelters, utilized by wandering hunters and stockmen. Any passer-by, according to the custom of the country, is at liberty to invite himself into a cabin if he happens to find one that is in use at all, and is supposed to give himself full rights and privileges, including the use of all solids and liquids. This is a sort of informal hospitality which prevails universally. The Indians, when compelled to risk dis-

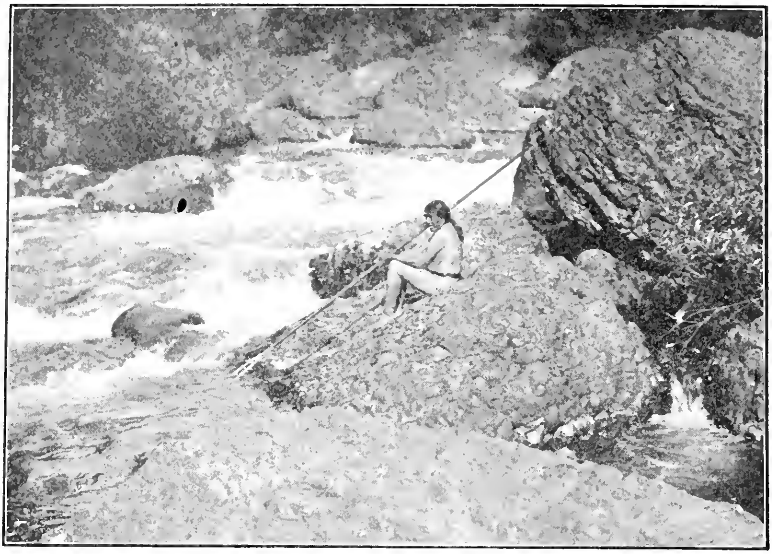
ISHI, THE LAST OF THE YAHI. From a photograph taken after his capture at Oroville, California in 1911. He is wearing a "slaughter-house apron" put on him before he was taken to town. His hair he had burned off with a firebrand, as a sign of mourning, throwing on water with his hands to keep from burning his scalp. The remaining photographs in this article were taken recently, after his appearance was much changed.



Ishi at the Present Time.

covery in visiting a cabin, took as much food as they possibly could, to lessen the chances of having to make another trip, and ran away. They usually made a systematic collection of everything eatable, down to the last scrap, and carried it off. While the mountaineer has liberal notions of hospitality, they do not extend to this. The visits of the Indians were bitterly resented. They left their unwilling host in most cases, on his return, no resource but to walk back to civilization, empty within and without.

Such food-gathering expeditions were conducted with true Indian slyness. In spite of the fact that such "robberies" were fairly frequent, and extended over a period of thirty years, the Indians were never seen. Not only that, but no one ever found so much as a track or footprint. Often the only trace the Indians left of their presence was a total disappearance of everything edible. On one occasion a white mother returned to her homestead from berry-picking with two small children, to find nothing in her larder but two cold boiled potatoes. On another occasion, two mountaineers, who left in their camp two months' provisions, found on their return only part of a sack of barley. On other occasions the Indians took from camps even the barley that was intended for horse feed. Many of these robberies might have been blamed to white men, except for the fact that stuff was taken which a white man would not bother with; for example, the barley just mentioned. While useless to a white, it was readily usable by starving Indians who were accustomed to making food out of acorns and grass



WATCHING FOR SALMON.

seeds, and had at hand their primitive devices for milling such things. On the other hand, the small quantities of canned stuff found in the cabins and camps were never touched. The Indians seemed to have a peculiar fear of it, perhaps from one or two unfortunate experiences, with canned goods that had spoiled. On at least one occasion there was taken from a cabin a small quantity of flour conspicuously labelled *poisoned*. No white man would have taken chances with this flour, however hungry.

More than once on such expeditions the Indians were perilously near exposure. Once an excited white man, with a repeating rifle and dogs, trailed them so closely that in crossing a stream they dropped a piece of headgear in their hurry. This headdress, fearfully and wonderfully wrought out of scraps of a dozen different fabrics, is now in our Museum. At the time of this escape the Indians were not seen, though where they had forded the stream the rocks were still wet.

Mere chance on several occasions nearly resulted in discovery for them. A hunter one time, passing along in the winter, noticed a low smoke rising out of a snow-covered thicket across a stream where he knew that no white man would have been. Later on, after the final emergence of the tribe from their obscurity, we found the remains of one of their encampments in this very thicket.

Such is the only actual evidence we have of the life of this tribe for over a generation. The most important change within that period is a shift in their habitat. After the massacre of '65 they lived at various places up and down the stream known as Mill Creek, robbing cabins when driven by famine. After 1885 however no more cabins were robbed along this stream. The Indians were evidently driven out by the in-

creasing degree of settlement. The next stream to the south is known as Deer Creek. The gorge through which this stream passes is rugged and wild in the extreme. It is in fact one of the most picturesque cañons in California. The wildest part of the cañon of Deer Creek was their last home.

Below the mouth of a side branch known as Sulphur Creek, the cliffs which hem in the main stream open out into a fairly wide valley. Between the base of the cliffs on the south side and the stream itself, is a long slope composed of lava detritus. This slope consists of rocks piled up in tremendous confusion, traversed with deep gullies, and overgrown with a perfect mat of scrub oak. The brush is so thick that it is practically impenetrable. Even sheep and cattle avoid the place. I doubt if such animals could make their way through it. Two or three miles through this thicket is a good day's work for a man. Here the Yahi tribe, or its remnant, found a final refuge. In one edge of this jungle, on a shoulder overlooking the stream, under some pepperwoods or laurel, they built some tiny lodges. To this locality and little village they gave the name of Bear's Hiding Place. The mountains and plateaus hereabout are useless for cultivation. The lava cliffs contain no metals. The country is quite unfrequented except for cattlemen and cowboys, who come at certain times of the year and "round up" their stock. Since the live stock never penetrated the jungle where the Indians lived, the stockmen also avoided it. Here for over twenty years the Indians lurked in peace.

They do not seem to have lived here exclusively. As far as we can

MAKING A SALMON-SPEAR. Two foreshafts, which are to carry toggles, are being fastened in place with cord.

gather at the present time, they ranged in the summer as far east as Mount Lassen. On the upper slopes of this tremendous peak they found plenty of game, and no one to disturb them. When it grew cold they returned to the foothills and passed the winter at Bear's Hiding Place. Near the lodges there is to be found a circular pit some three or four feet deep. This pit they were accustomed to pack full of snow. The melting of this snow gave them a supply of water and saved them the trouble and risk of going down to the creek, some five hundred feet below.

The village site has now been visited by a number of people, scientific and otherwise. I think they will all agree that the placing of the lodges was the work of people who were not only desperately anxious to hide themselves, but who knew thoroughly well how to do it. The houses were built where they were invisible from the cliffs on either side. The Indians passed down to the creek, which was very important to them on account of the fish in it, under the shelter of a growth of laurel. Thus they could move about and still remain hidden. Moreover, they avoided making visible trails, especially near the water. The little path that leads down from the lodges under and through the thicket, ramifies and disappears as it approaches the stream. In other words, they went down by different ways, to avoid making one conspicuous pathway. In making the needful paths through the brush, they bent aside the necessary twigs. Cutting or breaking them would have made the path much more conspicuous. I doubt if an observer on the cliff would ever have seen the Indians if he had been looking directly down upon them. Altogether, the place and its selection showed considerable evidence of craft, and to the wandering hunter or rider on the mountains round about, the locality would have looked always like a genuine bear's hiding place, for all the evndence of human habitation to be seen.

The Breaking Up of the Hidden Village

Such was the life of this group until the year 1908. At that time a party of surveyors, on engineering business, happened by mere luck to encounter them. One evening a naked savage was suddenly observed, standing on a rock by the stream side, armed with a long spear. This resulted, from all accounts, in the equal alarm of all parties. The next morning, those members of the party who had not run all the way to camp, went down to the place, cast about in the brush, and finally came upon the Indian lodges. Two Indians, running for their lives, were actually seen—one of them an old man, helped along by a middle-aged woman. This fleeting glimpse is all that we know of these individuals. They have never been seen again. Their actual fate is still unknown. In camp was found, under some blankets, a partially paralyzed old woman, frightened nearly to death, unable to move. The whites did what they could for this old person, then helped themselves, mainly in

a spirit of curiosity, to the contents of the camp—bows, arrows, skin blankets—and after prying about, went back to camp for dinner. When they returned next day the old woman was gone.

Such was the tragic end of the last remnant of the Yahi tribe. Except for one individual, our account closes here. The members of the tribe who were seen at this time seem to have perished from cold, hunger, and exposure, without ever returning to their camp.

Nearly three years later, in August, 1911, at a slaughter-house four miles from Oroville, eighty miles away, one morning there suddenly appeared from nowhere a naked Indian. His only garment was an old castoff undershirt. He was thin, hungry, greatly worn, and of most unusual appearance. The people in charge of the premises telephoned to the sheriff and reported with some excitement the presence of a "wild man." No one, Indian or white, could make him understand a word. The sheriff of Butte County came out, took the wild man in charge and gave him, as the most available lodging, the insane cell of the jail. When the news reached the university, the appearance of this strange Indian was at once connected with the Yahi tribe of Deer Creek, in which the department of anthropology had long been interested. It fell to the lot of the present writer to journey to Oroville to identify him. Our only resource was to "try him out" with a vocabulary in the Nozi dialect, since there was no material in existence in what was thought to be his own proper language. The first impression received of the wild Indian was the sight of him, draped in a canvas apron they had hurriedly put on him at the slaughter-house, sitting on the edge of a cot in his cell, still uncertain of his fate, and answering *ulisi* ("[I don't] understand") to all the questions that were being fired at him in English, Spanish, and half a dozen Indian languages, by visitors. The present writer's amateur attempts at Yana were equally unintelligible to him for a long time. An agreement was finally reached, however, on the word for the material of which his cot was made, *si'win'i*, or yellow pine. His face lightened up at this word, though he evidently could hardly trust his senses. These were probably the first intelligible sounds he had heard from a human being in three years.

Since those days he has become a regular member of the Museum staff. He has revisited Deer Creek cañon in our company, and there is not a foot of the country he does not know. There is not the slightest doubt that it has been his home. He led the party to the old lodges in the jungle at Bear's Hiding Place, he communicated scores of place-names up and down the stream for miles, and even led the way over to his old lurking places on Mill Creek, some distance to the north. In other words, he has told us all he could, in a general way, about the tribe. He has, however, been curiously backward in telling the intimate history of his own immediate group. He has gone so far as to say that the middle-aged woman who was seen was his sister, that the very old woman was

his mother, that the old man, however, was not his father. In general he speaks of them with reluctance. His reasons for this are not at all mysterious. These people are dead, and to the Indian that is ample cause for avoiding all mention of them. In the first place, if, in the world of spirits, they hear their names being mentioned, they may take it (horror of horrors!) for a summons. Hence to taboo their names or any conversation about them is mere commonplace caution. Moreover, to speak of them and their life makes the survivor sad. At worst, to mention the dead is dreadful; at best, it is a serious disrespect. For all of these reasons our surviving tribesman avoids talking of his own personal history. It is all mixed up with that of these other, deceased persons. It is impossible to discuss recent events without bringing in their names, so he usually prefers to talk of other things. He is always ready to talk at length about the general mode of life of his people—anything in fact that does not have personal details in it. He is anxious and enthusiastic in explaining his religious and mythical ideas. As a general thing, the more ancient the lore, the more volubly he discourses. We expect some day to insinuate ourselves behind his reserve, and learn the real history of his movements during the last three or four years before his "capture." His particular secretiveness in certain matters may be illustrated by the fact that he has never told us his own name. We address him usually in his own tongue as "Ishi," which means simply "man." His actual personal name is still unknown, and possibly always will be.

Two pictures are reproduced which were taken on the visit that he made in our company to his old haunts on Deer Creek. He was in familiar surroundings, thoroughly at home, told us details concerning the mode of life and enlarged in many directions on hunting and other tribal pursuits. Thus he named for us several hundred species of plants, and described in detail the uses to which his people put them. He is a very remarkable man, aside from his extraordinary personal history, and after all his hard life, very communicative and lovable. He is quite possibly, of all the Indians of North America to-day, the one who has most nearly the primitive viewpoint. His impressions of our civilization when we finally understand them will probably bring out many curious and interesting points. He will be able, moreover, to give us, from the primitive standpoint, information about a little-known chapter of history.

From time to time reports come in of evidence pointing to Indians who are still hiding away in the mountains east of the Sacramento. It is very hard in many cases to say just what the basis of these reports is. It is not absolutely impossible that there are one or more members of the Yahi group still wandering about in the wilderness. Let us hope that if there are any others of this group still alive we may ultimately succeed in bringing all of them together.

EXTINCT FAUNAS OF THE MOHAVE DESERT, THEIR SIGNIFICANCE IN A STUDY OF THE ORIGIN AND EVOLUTION OF LIFE IN AMERICA

By Professor JOHN C. MERRIAM

Introduction

IT is almost a rule that features of the natural world which have exerted an unusual influence in developing our emotional, poetic and religious natures, when brought within the range of scientific inquiry seem only more deeply to excite our wonder and respect. Thus, it has happened that the deserts of the world, having furnished the stimulus for some of our earliest poetic and religious literature, appear to the scientist of to-day as places in which nature meets us with unusual frankness, and where her wonders almost clamor to be understood.

In those fields of history covering the development or evolution of the external form of the earth and of the life upon it, deserts have been very significant sources of information, and the so-called bad-land formations in the arid or semi-arid regions of western North America have been recognized as playing a very important part. As the wide-spread exposures of these formations have elsewhere in America proved veritable museums of wonderfully preserved remains, it has seemed worthy of remark that the extensive bad-lands in the Great Basin region of America have with few exceptions furnished almost nothing bearing on the history of life. The early geologic explorers in Nevada and California found little bearing on the paleontologic story of the area they examined. Later investigators in the bad-lands of these regions have generally failed to report determinable vertebrate remains, and the life record has until recently remained practically a closed book. It has been with much interest, therefore, that those concerned with the history of western North America, and with its bearing on the whole story of life growth or evolution, have seen coming to light with the past decade chapter after chapter of this missing record.

With the exception of the John Day region of eastern Oregon, which supplies an important geologic and paleontologic record, the largest part of our knowledge of the history of mammalian life west of the Wasatch is obtained in the heretofore unexplored deposits of the Mohave Desert. At the present time there are available from the Mohave at least three extinct mammalian faunas previously unknown, or only imperfectly known, in the Great Basin. The life record given us by these faunas, the evolutionary series to which they contribute, and the suggestions

which they offer concerning the origin, evolution and world relationships of life in America, furnish very significant chapters in the history of the western side of the continent.

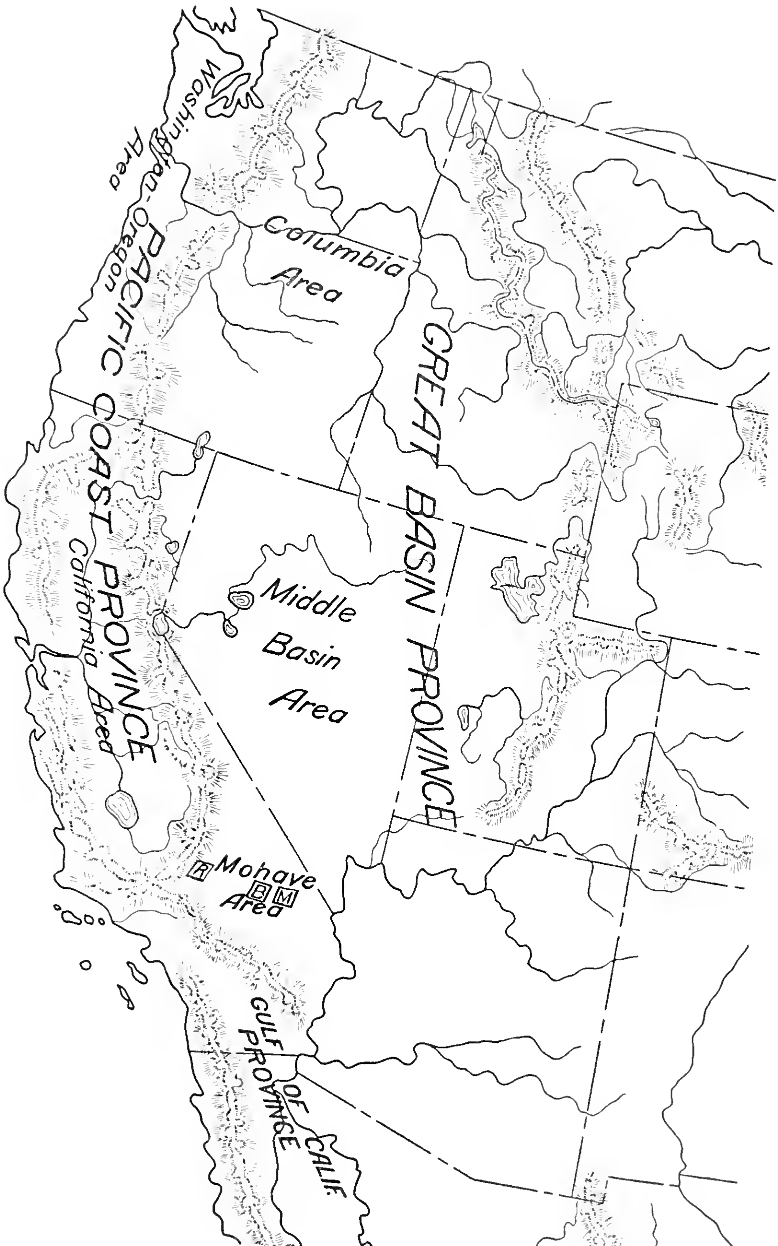
Nearly twenty years ago several very fragmentary specimens from the Mohave were forwarded to the writer by Dr. Stephen Bowers, the material having been obtained in part by John T. Reed. The earliest material from definitely known localities coming to the writer was received in the spring of 1911 from John R. Suman, then a student at the University of California. The collection consisted of a small quantity of loose bones and teeth obtained on the desert by H. S. Mourning. These specimens furnished the basis for the first study of the Upper Miocene fauna of the Mohave. In the following year C. L. Baker, a fellow in paleontology at the University of California, visited the localities reported by Mr. Mourning and secured a fine collection of mammal material from the Miocene near Barstow, and a small amount of material from the Pliocene at Ricardo. Other important collections were made later by Mr. Baker, Mr. Mourning, Mr. J. P. Buwalda and by many students in paleontology from the University of California. Following his work on the Mohave in 1913, Mr. Buwalda independently visited a locality in the eastern portion of this region, and obtained a most interesting collection of Pleistocene remains in a formation to which he has given the name Manix beds. This material gave us for the first time a representative group of vertebrates from the Pleistocene of the Great Basin.

The collections brought together at various times have opened to us a view of the mammalian life of the Mohave Desert in three periods: the Barstow fauna of Upper Miocene age, the Ricardo fauna of early Pliocene stage and the Manix fauna from the Pleistocene.

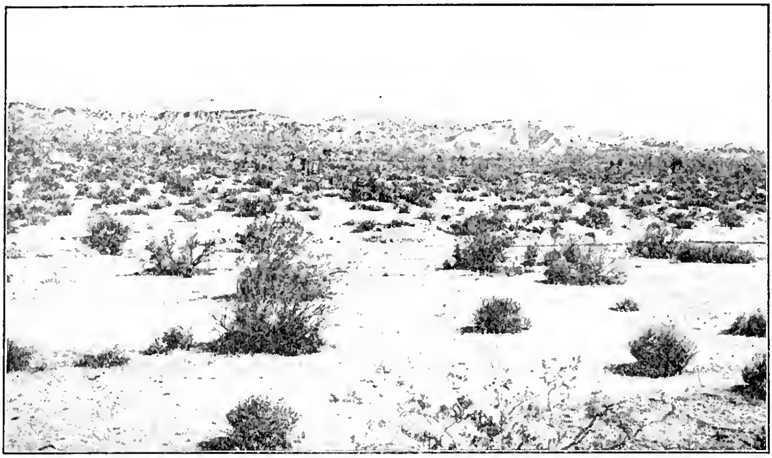
The Mohave Desert of To-Day

The Mohave Desert area of California has been generally recognized as one of the least attractive portions of the southwest. It has been described as a forbidding land of heat and thirst. The deception of its mirages is a current example of the lure of unreality, and its great stretches of sand and dust have appeared to function mainly as barriers to human progress. The history of exploration has seemed amply to justify current views concerning the desert, as year after year prospectors or explorers, deceived by distances or miscalculating the position of scattered water sources, have paid with their lives the penalty for inaccurate judgment.

In spite of seeming obstacles offered to one who would make its acquaintance, those who have come to know the Mohave seem always to cultivate the friendship. The prospector has cheerfully risked his life,



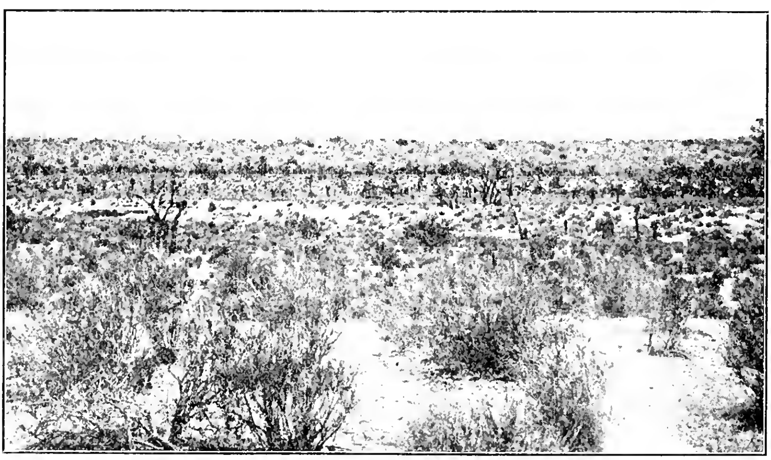
OUTLINE MAP SHOWING RELATION OF THE MOHAVE AREA TO OTHER PACIFIC COAST AND GREAT BASIN REGIONS DURING THE LATER GEOLOGICAL PERIODS. Within the Mohave region the principal faunal localities are indicated as follows: *B*, Barstow fauna; *R*, Ricardo fauna; *M*, Manix fauna.



CHARACTERISTIC VIEW OF THE MOHAVE DESERT IN THE VICINITY OF THE FOSSIL BEDS. (Photograph by C. L. Baker.)

not alone for the desire of gain, but because the fascination of the desert always increases. The traveler is inevitably deeply influenced by the uncertain magnitude of distance, by the silence, and the unusual forms and brilliance of the landscape by day and night. Once an acquaintance is formed, distrust and fear are replaced by reverence of the quiet strength of nature exhibited here in factors which are too large or too elusive to be fully comprehended.

The Mohave lies in the middle of the southern half of the state of California, the desert proper being situated in the angle where the Sierras turn west to meet the Coast Ranges. The western limits of the



CHARACTERISTIC VIEW OF THE MOHAVE DESERT; showing at this locality an unusual abundance of vegetation, consisting of creosote bushes and Joshua trees. (Photograph by C. L. Baker.)

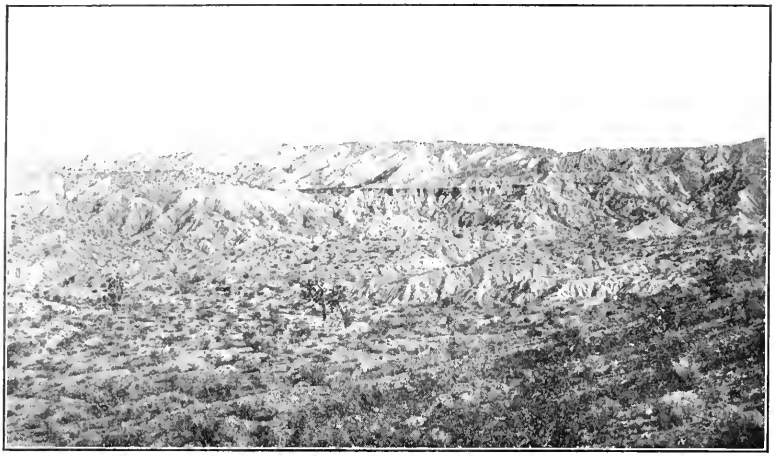
area are sharply marked by the abruptly rising wall of the bordering mountain ranges. The limits to the east are not so clearly marked, being considered by some to reach the eastern border of the state; by others they are held to extend less than half the distance to the Colorado River.

The elevation of the desert floor ranges from 2,000 ft. approximately to 4,000 ft. above the sea, in sharp contrast to the basin of the Salton Sea, which extends below the level of the ocean a short distance to the south. The topography of the region is characterized by great stretches of open plains many miles in extent, over which scattered mountain peaks or ranges are distributed with little suggestion of order in their arrangement.

The total rainfall of the desert amounts only to a few inches per year. Living streams are rare, and travel in all of this region is necessarily limited by accessibility of the few localities at which potable water can be obtained. Rain falls largely in the middle of the winter season, and throughout the greater part of the year there is no precipitation. The water at times comes with a rush, flows off rapidly as floods, and sometimes causes considerable damage to artificial obstacles in the path of the current. With the exception of the Mohave River, which runs a thin superficial stream for a considerable portion of the year, there are very few points at which a supply of water can be obtained on the surface. Investigation has shown that artesian water is available over certain areas, and agriculturists have operated to some extent by irrigation with water obtained from wells.

The diminished rainfall, the unhindered influence of a brilliant sun and the moderate altitude have given to the Mohave a distinctly arid climate: and with the climate go all of the accompanying characteristics of life, of erosion and deposition, and of the peculiar land forms of an arid country.

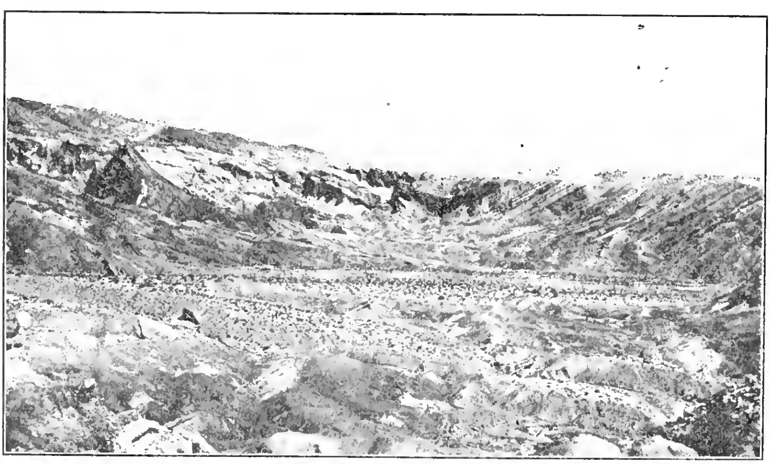
The vegetation of the Mohave area is at the present time limited mainly to desert types, the contrast with the flora beyond the ridge immediately to the west being very marked. In crossing the Tehachapi Range from the Great Valley of California to the Mohave one finds the valleys of the western side thickly studded with oak, sycamore, and willow, and the hills are carpeted with grass. On the eastern slope the whole aspect of the vegetation changes suddenly, as if one were entering a foreign land. The yuccas and the creosote bush replace oak and grass, and the oddly outstretched arms of the Joshua trees seem everywhere raised up as if to attract attention. Plants of arboreal type are rare, and, excepting a few junipers, the yuccas furnish the only trees. Creosote bushes are generally present, but are sometimes sparingly represented. Perhaps to show that under adverse conditions nature means only to be just and not unkind, the spring and early summer find the



Typical Exposure of the Fossil-bearing Barstow Miocene Formation North of Barstow. (Photograph by C. L. Baker.)

desert dotted here and there with patches of flowers of unusual beauty and fragrance, offering their charms as an antidote for the misery of thirst about them.

The living mammalian fauna of the Mohave comprises thirty-five species, of which twenty-one are rodents. The Ungulata are represented only by the pronghorn antelope and the desert big-horn. The Carnivora include the desert coyote, the Mohave Desert kit fox, the California raccoon, a spotted skunk, a striped skunk, the northwest cougar, and the desert wildcat. The rodent fauna includes thirteen genera. The species are mainly characteristic desert forms. Of the living mammals only a few genera are known also in the older faunas of



Folded and Faulted Strata Representing a Portion of the Section Containing Fossil Remains North of Barstow. (Photograph by C. L. Baker.)

the Mohave. Some of the existing types, as the bighorn, are immigrants from the Old World, and arrived very late in the history of this region. Others, as the pronghorn, are evidently of American origin.

Geologic Occurrence and Age of the Mohave Fossil Beds

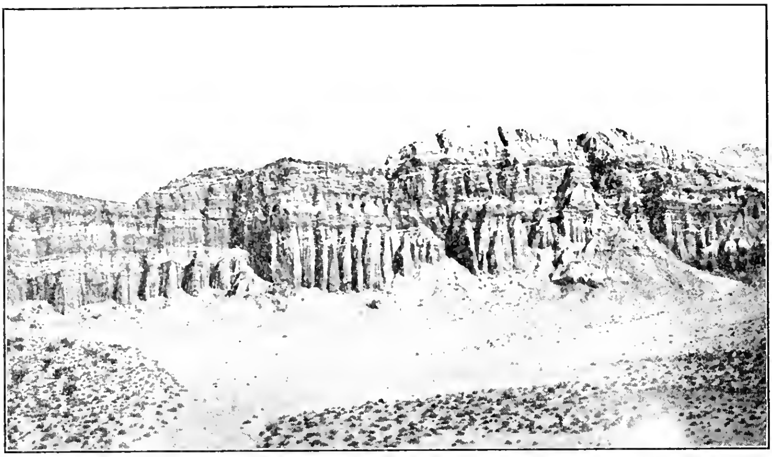
The Miocene and Pliocene faunas in the Mohave area occur in an accumulation of strata amounting to not less than 7,000 to 8,000 ft. in thickness. The beds consist in large part of volcanic materials which are interstratified with clay strata, shales, and desert conglomerates. The origin of the immense quantities of ashes piled up in these formations is as yet unknown. They were probably derived from volcanoes and other channels for extrusion of lavas and ash in or near the Mohave area. In a few strata abundant remains of fresh-water mollusks indicate deposition of these beds in fresh-water ponds or lakes. At other levels the skeletons of large desert tortoises and numerous remains of land mammals now characteristic of flat open country suggest accumulation upon dry land.

Mr. Baker considered that the Miocene and Pliocene deposits of the Mohave were formed mainly under physical conditions similar to those operating in the desert at the present time. As nearly as the writer can judge, the climate conditions in the Mohave area through the period in which the mammal beds were being laid down, were those of a semi-arid region somewhat more humid than the Mohave of to-day, and the climate corresponded approximately to that now obtaining in the southern end of the Great Valley of California.

Sections of the older formations containing fossils in the Mohave area are most satisfactorily shown in great thicknesses of strata exposed in the hills north of the town of Barstow, and in excellent exposures at Ricardo between the eastern foot of the Sierras and the El Paso Range. At both localities exposures extending for many miles give unusual opportunity to examine the structure of the formations, and bring to view the strata containing mammalian remains. As shown in the accompanying photographs, the formations at these localities are sculptured by erosion into most fantastic shapes, like those of the famous bad-land forms of the western Great Plains region. In the intricate gullies and caverns of these exposures there is found a most fascinating field, in which to hunt for the big game of the Mohave of ancient times.

The oldest fossil-bearing beds of the Mohave area rest upon a basement consisting in part of granite and metamorphosed or altered rocks of pre-Tertiary age. They may also rest upon extruded igneous rocks, presumably at least as old as Lower Miocene.

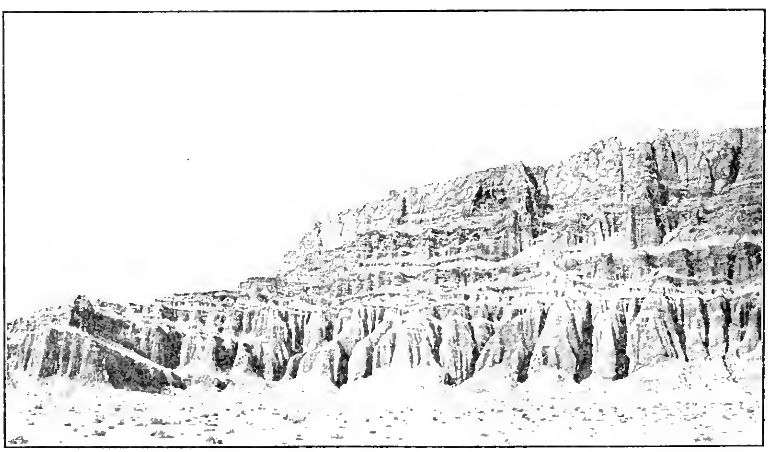
The oldest known strata containing vertebrate fossils in the Mohave area are found in the Upper Miocene near Barstow. Leaves stated to be of Eocene age were collected by H. W. Fairbanks at Black Mountain



TYPICAL EXPOSURE OF THE RICARDO PLIOCENE NEAR RICARDO. (Photograph by C. L. Baker.)

in the El Paso Range on the western border of the desert, but no additional material representing this stage has as yet been found.

To the whole series of older or Tertiary sediments of the Mohave area, O. H. Hershey has given the name Rosamond series. Mr. Baker has shown that the series is divisible into a number of quite distinct divisions. Some of these may represent quite widely separated periods. Evidence which the writer obtains from a study of the faunas indicates that the deposits north of Barstow containing a Miocene fauna, may represent a formation quite distinct from that at Ricardo containing a Pliocene fauna. The term Barstow formation is used for the beds containing the Upper Miocene fauna. The lower portion



EXPOSURES OF RICARDO PLIOCENE, SHOWING CHARACTERISTIC BAD-LAND STRUCTURE IN OUTCROPS NEAR RICARDO. (Photograph by C. L. Baker.)

of the Barstow section may be considerably older than Upper Miocene and may constitute a distinct formation. The name Ricardo formation is used for the strata with a Pliocene fauna at Ricardo.

The youngest fossil beds of the Mohave region appear in a small basin about 20 to 40 miles east of Barstow. The deposits cover an area about 25 miles in length and represent accumulation in a small body of fresh-water, to which Mr. Buwalda has given the name Manix Lake. The deposits consist of clays and sands aggregating about 75 feet in thickness. Their accumulation was initiated by the raising of a barrier across the Mohave River drainage, causing the ponding of the river which formed Manix Lake. The lake disappeared and deposition ceased when the river cut through the barrier across its path.

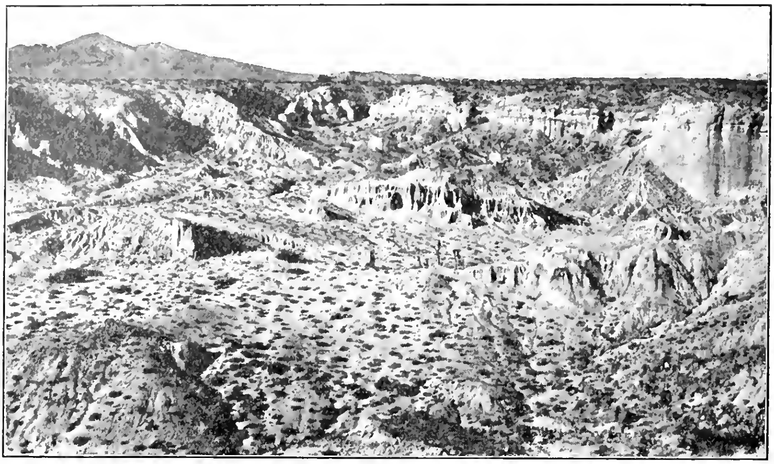
Remains of extinct vertebrates are found over a wide area in the deposits of the Mohave region. They are not abundant in many places, and one may search long for even a fragment of a bone or tooth. In a few localities fragmentary specimens were found scattered over the ground in considerable numbers, but connected parts of skeletons are rare. At several points where bones were found well exposed, and in their original position in the rock, they seemed to be scattered and disconnected, showing that the parts of skeletons were generally widely separated and broken or weathered before final burial. The process of entombment was probably similar to that in operation on the desert at the present time, where bones of horses and cattle are pulled apart by coyotes, scattered by rain-wash, and in a large measure rotted away before any portion of the animal is permanently covered over.

The collections obtained include several thousand specimens, mostly teeth and portions of limb-bones. In a few cases, good jaws and parts of skulls were secured, but unlike the occurrence in many of the formations in the west, these beds seem almost never to contain complete skeletons.

In the Miocene beds of Barstow vertebrate remains are found almost exclusively in the uppermost zone. In the Ricardo Pliocene fossil remains were found in several parts of the section, but the best representation of the fauna appears near the middle and toward the top of the formation.

Although only a few localities have been found at which even small collections of mammalian bones can be obtained in the area of the Mohave region examined, it is evident that deposits representing the formations in which bones occur are very widely spread over this area, and future exploration may be expected to add greatly to the information now available.

The formations containing mammalian faunas in the Mohave area, and their approximate relations to the recognized geological scale are as follows:



A Basin in the Ricardo Pliocene near Ricardo. (Photograph by C. L. Baker.)

Geological Periods		Mammal Beds of the Mohave Area	Recognized Formations of other Western Areas
Pleistocene		Manix Beds	Rancho La Brea, California
Pliocene	Upper		
	Middle		
	Lower	Ricardo Beds	Thousand Creek, Nevada Rattlesnake, Oregon
Miocene	Upper	Barstow Beds	Cedar Mountain, Nevada
	Middle		Mascall, Ore. and Virginia Valley, Nev.
	Lower		Columbia Lava of Oregon

Ricardo Pliocene at Ricardo. This is one of the most important fossil localities in the Ricardo formation. (Photograph by C. L. Baker.)

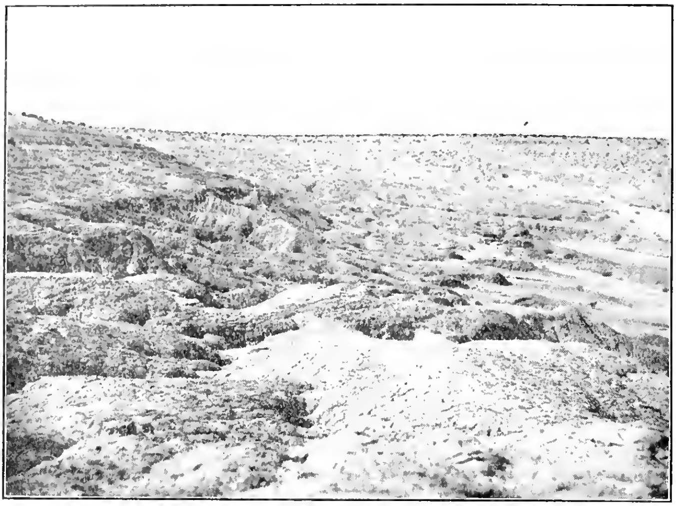
The Oldest Known Mammal Fauna of the Mohave, the Upper Miocene of Barstow

The fauna of the oldest mammal-bearing beds of the Mohave area includes about thirty species, many of which are known only by fragmentary material. The larger part of the collection consists of the remains of horses and camels. The bones of horses, accompanied by those of other animals, are sufficiently abundant at one horizon to mark a zone or layer which can be traced for a number of miles, and is known as the Merychippus zone, from the most common fossil, a little three-toed horse of the genus *Merychippus*.

Of the horse there are at least four species represented. *Merychippus* is the most abundant form and includes two or three types. They were mainly animals about as large as small colts of the modern horse. They possessed one large middle toe and two small, scarcely-functional side toes on each foot. Their heads were long and had peculiar depressions on the sides of the face. The back-teeth were long, and as they were worn off from the top, they grew up from the root, as in the modern horse. These animals were of a distinctly open country or plains type, and evidently supported themselves by grazing or grass-feeding, rather than by browsing from brush as do the deer. One of the larger species of *Merychippus* is almost indistinguishable from the genus *Protohippus*, the next or later stage in the evolutionary series of the horse. An exceedingly rare form related to *Merychippus* is represented by a few large teeth which may possibly belong to a representative of the genus *Pliohippus*, a larger animal somewhat like the modern horse. One of the most common *Merychippus* species is a small form approaching in its characters the genus *Hipparion*, the characteristic horse of the following Ricardo or early Pliocene epoch. The Ricardo Hipparions are possibly descendants of this small Barstow horse.

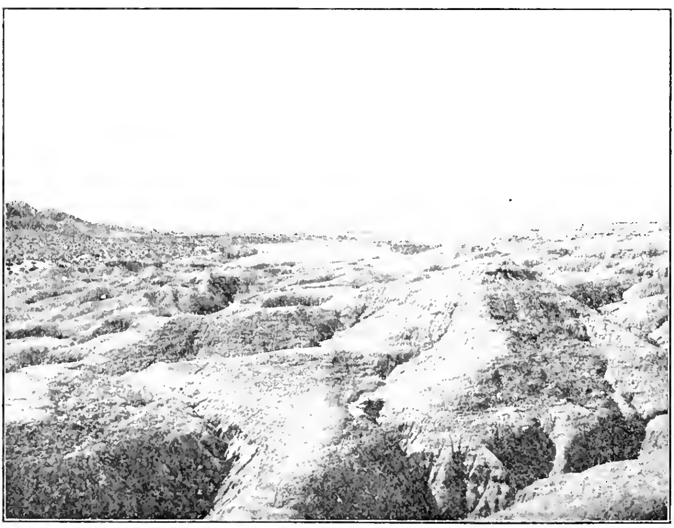
Two rare horses found in the Barstow fauna, like the earliest forms of the horse group, have back-teeth with short crowns not adapted for grazing. One belonging in the genus *Hypohippus* was a large three-toed animal, in which the side-toes are much larger than in *Merychippus*. The teeth are those of a browsing, not of a grazing animal. The feeding habits of this horse must have differed very considerably from those of *Merychippus*, and it probably occupied a somewhat different range. The other rare form represents a species of *Parahippus*, also of a browsing rather than of a grazing type. It may be repeated that *Hypohippus*, *Parahippus* and *Protohippus* are collectively known only by a very small number of specimens. The grazing *Merychippus* is the common and characteristic animal of the fauna.

Associated with the horses are rare remains of a primitive wild pig or peccary. There is also a rare oreodon, one of the late representatives of a large family, which is perhaps the most characteristic American



Characteristic Exposure of the Manix Pleistocene Lake-beds on the North Bank of the Mohave River near Field Station in the Manix Basin. (Photograph by J. P. Buwalda.)

mammal group in the whole history of our fauna. It included creatures resembling on the one hand the pigs and on the other hand the camels and deer. There are also rare remains of a large antelope or deer of the genus *Dromomeryx*. A small deer-antelope, *Merycodus,* a dainty creature with teeth like an antelope and horns like a deer, is represented at several localities by abundant fragments of teeth, limb-bones and



Bad-land Structure in the Manix Basin. (Photograph by J. P. Buwalda.)

antlers. A large four-tusked mastodon is known by numerous fragments and occasional complete bones or large pieces of tusk.

Next to the horses the most numerous of the hoofed animals are the camels. They are known by at least three types. One is a small form of the genus *Procamelus*. A second and very large type probably belongs to the genus *Pliauchenia*. A third form with very large long limbs, a larger animal than the living camel, is possibly to be referred to the genus *Alticamelus*. Other genera may be present in the collection.

Of the remaining fauna, the rodents are represented by rabbits. The carnivores are known by at least eight species, including three large cats, at least one of which is a sabre-tooth with the greatly developed upper canine teeth. Two others may belong to the true cats, represented by the modern puma and wild cat, without the saber-like upper teeth. The dogs include one small form similar to the fox. A second type, *Tephrocyon*, one of the most characteristic animals of this horizon, is a form considered by many to be possibly the ancestor of the modern dogs and wolves. The most abundant creatures of the dog group are found in one or two representatives of the genus *Aelurodon*, very large, very heavy-jawed animals, much larger than any modern wolves, and even greatly exceeding the extinct dire wolf, now so well known by abundant skeletons from the asphalt deposits of Rancho La Brea. These animals were evidently not rare. They probably lived off the herds of large ungulates, sometimes bringing down a live animal, sometimes robbing the smaller wolves and the big cats of their prey. Their unusually massive jaws and teeth seem built to serve as bone crushers, and there can be little doubt that the general state of dismemberment and destruction of all skeletons, and the absence of satisfactory paleontologic materials in the Barstow formation, is due in large part to the destruction of these scavengers.

Birds are known in the Upper Miocene beds by a few fragments representing an owl. Reptiles are represented by numerous fragments, and several nearly perfect skeletons of a large tortoise resembling in many respects the living desert tortoises of the Mohave.

The fauna of the Upper Miocene is as a whole that of an open country affording fairly abundant grass and herbage, and evidently better watered than the Mohave Desert of the present day. The numerous remains of grazing horses of the *Merychippus* type, the presence of mastodons, oreodons, of many deer-antelope, a considerable variety of camels, and a wild pig all indicate that grass and other nutritious vegetation must have been more abundant than at present. The relatively small representation of oreodons, and of browsing horses like *Hypohippus*, and the presence of large tortoises are possibly to be correlated with open semi-arid character of the country.

That small bodies of water were present at times in this area is

shown by the presence of many fresh-water molluscan remains at certain horizons.

The fauna of the Barstow beds represents a stage in the evolution of Tertiary mammalian faunas previously not distinctly recognized in the Great Basin Province. It seems clearly later than the Middle Miocene life stage well known in the Mascall beds of Oregon and in the Virgin Valley beds of northern Nevada. The fauna is markedly older than the Rattlesnake Pliocene of Oregon and the Thousand Creek Pliocene of Nevada, representing the next described stages following the Middle Miocene in the Great Basin. The fauna of the Barstow beds has few if any species in common with that of the Ricardo formation, and is of a distinctly older type. Its nearest relationships are with the fauna of the Cedar Mountain region of southwestern Nevada, from which it possibly differs somewhat in stage.

The Second Fauna, the Ricardo Pliocene

The number of species represented in the Ricardo fauna is approximately equal to that found in the Barstow Miocene and the groups of animals represented are in general of the same type. Comparisons between these two faunas or life stages can therefore be made with some degree of satisfaction. Coupled with the fact that the Mohave and Ricardo faunas comprise an approximately equal representation of similar groups, it is a matter of interest to note the almost complete difference between the species represented in the two, and that with one or two possible exceptions the species of the Ricardo stage represent more specialized or more progressive stages of evolution than the corresponding types seen in the Barstow fauna.

As in the Mohave stage, we find the Ricardo collections consisting mainly of horses and camels, the horses furnishing the most important and most characteristic forms thus far known.

The Ricardo horses are of at least three types, of which the most common includes one or more species of the genus *Hipparion*. These are large, three-toed forms with the side-toes reduced and the grinding teeth large. They resemble to some extent one of the small species of the Barstow Miocene, but are much larger; the side-toes are more reduced; and the teeth were longer-crowned, heavier, and of more complicated structure. The Ricardo *Hipparion* differs from most of the species referred to this genus in America, and belongs to the true *Hipparion* type, which J. W. Gidley considers as characteristic of the Old World, in contrast to a New World form, *Neohipparion*. Many of the teeth of the Ricardo species are practically indistinguishable from these of *Hipparion richthofeni*, a species abundantly represented in the early Pliocene or late Miocene of China. It has generally been assumed that the Old World horses of the *Hipparion* type are descended from

North American stock. No types from which *Hipparion* might presumably be immediately derived by evolution are known in the Old World formations of the period just anterior to that in which *Hipparion* first appears, whereas in North America stages of evolution leading toward *Hipparion* are found in formations representing the period preceding the birth of this genus. So far as the writer's observations have been carried, an evolutionary sequence leading to the genus, *Hipparion* is nowhere more clearly suggested than in the relation of the *Hipparion* of Ricardo to the Hipparion-like *Merychippus* of the Barstow Miocene. It seems not improbable that the Old World *Hipparion* is derived from a West-American form near the Barstow *Merychippus*.

Living in the same region with the *Hipparion* in Ricardo time were at least two other types of horses of an advanced stage referred to the genus *Pliohippus*. The animals of these species were nearly as large as the smaller forms of the modern domestic horse. Their teeth were long-crowned and well adapted to grazing as in existing forms, but their feet still bore small side-toes somewhat as in *Merychippus* of the Barstow. The pattern of their teeth is quite unlike that of the *Hipparion* and considerable differences separate them in skeletal structure. They presumably occupied a different niche in the organization of the fauna, but what it was is not entirely clear.

In the Ricardo fauna, as at Barstow, we find a rare oreodon, the last representative of this important family known west of the Wasatch. The Ricardo type follows the rule in being more specialized than that in the Barstow Upper Miocene. Little deer-antelope much like those of Barstow are also known by the last representatives in the Great Basin. Rodents are rare. The mastodon group is still represented by animals with four tusks, a pair being present in the lower jaw as well as one in the upper jaw.

Of the camels there are several species known from Ricardo. They represent genera similar to those in the Barstow Miocene, but are generally of larger type, and are presumably in a large part specifically different. Carnivores are relatively abundant. Large heavy-headed ælurodons like those of Barstow are present, but possibly all belong to new species. With these are other forms of the same group, but larger and stronger. There is a marten of a new species. Of the cats, one is a saber-tooth of a rare type somewhat similar to a species known in India. One specimen, belonging to a gigantic animal of the *Felis* or true cat type, was at least as large as a male African lion of the present day. Another specimen is from a smaller cat possibly like a puma.

Large tortoises are known in the Ricardo, as at Barstow. At least one form seems to differ in its character from the Barstow species.

In the table on page 262 a comparison of the Ricardo and Barstow faunas would show almost complete specific separation of the life stages.

This difference extends in a considerable measure to groups of the rank of genera; as in the case of the horses, in which *Hipparion* replaces *Merychippus*. As has been noted above, in nearly all cases in which it has been possible to make a satisfactory comparison of animals in similar groups, the Ricardo types are seen to be more specialized or more progressive. In the Carnivora the common *Tephrocyon* of the Mohave seems to have disappeared. A single specimen shows some resemblance to that genus, but is not comparable to any Barstow species. The heavy-jawed ælurodons, which are the characteristic canids of the Ricardo fauna, seem to be mainly, if not entirely, distinct, and are generally more specialized than those from the Barstow beds.

The fauna of the Ricardo beds is widely different from that of the Middle Miocene west of the Wasatch, and is distinctly more advanced in the stage of progress or evolution. It is quite different from the Lower Pliocene of Thousand Creek of Northern Nevada, and seems less advanced. It differs so far as known from the Rattlesnake Lower Pliocene of Oregon, and is possibly somewhat older.

The beds in which the Ricardo fauna occurs were evidently deposited on plains lying at the eastern base of a Pliocene Sierra range rising to a height of several thousand feet above the level of the Great Basin region. The elevation of the Mohave area as a whole was probably not greater than at present, and may have been somewhat less. The Ricardo deposits are probably in part land-laid and in part water-laid. The volcanic material which they contain may at times have accumulated rapidly, but seems in general to have been deposited so slowly that the region was nearly continuously habitable.

The Ricardo fauna consists largely of forms that would naturally prefer to inhabit plains areas, or might thrive in partly open, level regions at least as well as in other environment. *Hipparion, Pliohippus*, the camels, and *Merycodus* would find this a favorable habitat. The carnivores associated with them would not necessarily find the surroundings unfavorable, provided sufficient cover were available. The mastodons and oreodons might inhabit the plains or frequent the border of the mountain area to the west. There are no elements in the Ricardo fauna which are necessarily considered as representatives of a forest or mountain assemblage washed or carried out on the plains.

The Ricardo fauna suggests climatic conditions permitting the development of vegetation suitable for grazing animals. This indicates a somewhat heavier growth of grass than is found in the Mohave at the present time. There is nothing in the constitution of the fauna to suggest conditions radically different from those obtaining in this region to-day, but the presumption is in favor of less extreme aridity than is now known on the western border of the desert. The conditions obtaining here in Ricardo time were probably more nearly like the

present environment in the southern portion of the Great Valley of California.

THE LATEST EXTINCT FAUNA OF THE MOHAVE, THE MANIX PLEISTOCENE

The fragmentary remains obtained by Mr. Buwalda from the deposits of Manix Lake include only scattered bones and teeth with a few shells of snails and clams. The collection includes the bones of two horses of the genus *Equus*. One is a large species evidently closely related to the existing horses. The other is a much smaller form, but evidently of the same genus. There are two camels; one near the size of the dromedary, the other much smaller. The larger camel was probably near or incidental with the large *Camelops* known by splendid specimens from Rancho La Brea. The other species is unlike any Pleistocene camel described from the west. There are bones of a proboscidean, probably an elephant. A large antelope, probably like the pronghorn is known by a single bone. Two birds like existing species are found in this fauna. The molluscs are fresh-water species closely related to living forms.

As fragmentary as is the material from the beds of Manix Lake, it represents the first assemblage of mammalian species of Pleistocene age from a definitely known horizon in the Mohave region. It is, in fact, the most important collection made at any single locality in the Pleistocene of the Great Basin. It gives for the first time a grouping of the most important mammalian forms living together in this region at any particular stage in the Pleistocene.

Taken alone these fragmentary specimens might never tell more than a very short story, but the wonderful Pleistocene collection obtained at Rancho La Brea just across the range to the west will ultimately furnish comparative material adequate to make possible a definite determination of the animal represented by every bone found in the Manix beds.

The Manix fauna is entirely distinct from that of the Ricardo. The horses are of the latest and most advanced genus, that is the modern *Equus,* which includes most of the living representatives of the horse group. The larger camels seem to represent the last genus known in North America. The relationships of the smaller camel are as yet uncertain. If the antelope is near the pronghorn, as seems probable, it is also of the latest known type.

It is perhaps unnecessary to state that the Manix fauna differs from that of the present day in the inclusion of camels and a proboscidean. When it is better known, this fauna will probably be found to contain few if any modern species.

Comparative Table Showing Known History of the Mammalian Faunas in the Mohave Area.

Recent	Pleistocene	Pliocene	Miocene
Desert Fauna	Manix	Ricardo	Barstow
Reptilia	*Reptilia*	*Reptilia*	*Reptilia*
Tortoise		Tortoise, large	Tortoise, large
Rattlesnake			
Carnivora	*Carnivora*	*Carnivora*	*Carnivora*
Desert coyote		Aelurodon, 3 species (Heavy-jawed dogs)	Aelurodon, 2 species (Heavy-jawed dogs)
Desert kit fox			Tephrocyon (Possible ancestor of modern wolves)
		Dog, small	Dog, very large
		Ischyrosmilus (Sabre-tooth cat)	Dog, small
Cougar		True cat, very large	Sabre-tooth cat, large
Desert wild cat		True cat, medium size	True cat, very large
California raccoon		Marten	
Spotted skunk			
Striped skunk			
Ungulata	*Ungulata*	*Ungulata*	*Ungulata*
	Equus, large (Horse)	Hipparion, 2 species (Advanced grazing-horse, 3-toed)	Hypohippus (Forest-horse, 3-toed)
	Equus, small (Horse)	Pliohippus, 2 or 3 species (Advanced grazing-horse, 3-toed)	Parahippus (Browsing-horse, 3-toed)
			Merychippus, 3 forms, abundant (Grazing-horse, 3-toed)
			Protohippus, rare (Advanced grazing-horse, 3-toed)
	Camelops? (Camel, large)	Procamelus?, (*a*) (Camel, small)	Procamelus (Camel, small)
	Camel, small	Procamelus?, (*b*) (Camel, small)	
		Alticamelus? (Tall camel)	Alticamelus?, (Tall camel)
		Pliauchenia? (Camel, very large)	Pliauchenia? (Camel, large)
		Merycochoerus?, (*b*) (Oreodon)	Merycochoerus (*a*) (Oreodon)
Prong-horn antelope	Antelope, large (Prong-horn?)	Merycodus (Deer-antelope)	Merycodus (Deer-antelope)
			Merycodus? (Crowned deer-antelope)
			Dromomeryx (Antelope-deer)
Desert bighorn sheep			
	Proboscidea	*Proboscidea*	*Proboscidea*
	Elephant or Mastodon	Tetrabelodon? (Four-tusked mastodon)	Tetrabelodon? Four-tusked mastodon)
Rodentia	*Rodentia*	*Rodentia*	*Rodentia*
Numerous genera and species	Fragments only	Fragments only	Fragments only

At the present time we are not in a position to state definitely the exact position or relationship of the Manix fauna with relation to other Pleistocene life in the west. The problem of the Pleistocene in this region is complicated and large, and the many elements still require much study before their interrelations can be determined. The Rancho La Brea fauna seems to contain elements similar to those of Manix, whether it is older or younger is not yet entirely clear.

The significance of the Manix fauna in relation to its environment is unfortunately not large. The presence of camels, horses, and antelopes indicates a climate somewhat more humid than that in this region at the present time, and such was the suggestion furnished by Mr. Buwalda's work on the physical history of the Manix Lake basin.

Significance of the Faunal Succession in the Mohave

The physical history of the Mohave area, in the time that has passed since the accumulation of the oldest formation containing a mammalian fauna in this basin, is only a small part of the long and complicated geologic story of the region; but the changes that have occurred since the earliest of these records of life were completed take on stupendous proportions when measured against human standards of stability. Since the deposition of the oldest beds of the Barstow section, not less than 8,000 ft. of known sediments have been laid down in this region, and there are evidences of long periods from which the only record that we have is of erosion instead of deposition. The strata of both the Barstow and Ricardo sections have been subjected to extreme movements of the earth's crust in folding and faulting or breaking. They have also been extensively eroded or worn down, and the strata now exposed can be considered only as remnants of the original mass. In terms of accumulation and erosion of deposits, judged by the best estimates that we can make, the lapse of time since burial of the oldest mammal remains in this region must be very long.

Physical changes of great significance in the history of this region, and of the life in it, are also noted in variations in the nature of the bordering mountain ranges. At present the Mohave owes its distinctive characters in large measure to separation from the Pacific coast by high ridges to the west. Throughout a large part of the known life history of this region, a barrier seems to have existed between the Mohave area and the Pacific coast province. The height of the separating wall has presumably varied much, being relatively small in Miocene time, and probably reaching its maximum since the Ricardo Pliocene. Variation in height of the barrier depended on the balance between erosion constantly wearing it down, and on the magnitude of crustal movements concerned in the making of the mountain chains. To some

extent variation in physical conditions in the Mohave has therefore been related to stages in the life of our great ranges. The latest period in the history of the mountains is the stage in which the peaks and valleys were modeled to their present form through gradual wearing down by ice, water and chemical decay. The clearly visible evidences of this last epoch mark for us a period longer than the full span of human history. In the story of the mountains, the earlier stages standing in relation to the history of life on the Mohave are observed only through study of a complicated geologic problem, but the measure of these early stages in time is far longer than that of the latest epoch.

The Barstow, Ricardo and Manix faunas present three stages in the life history of the Mohave area within the extent of a long period marked by many great physical changes. The records of these faunas are incomplete, and should be considered only as imperfect pages from a volume that has passed through fire, flood, earthquake and decay incident to the passage of almost limitless time. As fragmentary and unsatisfactory as the story is, it opens to us a wide vision of previously unknown life history in this region; it offers significant evidence regarding the origin, evolution and migration of important mammal groups; it furnishes information concerning the climatic history of the Mohave; and it contributes largely to our knowledge of the chronology of great crustal movements in western North America. If this were the only record known in the world, from it alone we could gather evidence that the life of the earth is very old, that this life has completely changed from time to time, and that in each successive fauna there was a nearer approach to the life types now in existence. We might not be able from the Mohave story to demonstrate the fact of evolution, as the fragments are small, and represent periods so widely separated that the suggestion of continuity is indistinct. Taken in connection with the great volume of records now available from other regions of the world, the Mohave story serves in a modest way to fill gaps in the previously known history; and in its close relationship to faunas remotely separated from it geographically, it illustrates the faunal unity of the world as a whole when the broader outlines of evolution are followed through long periods.

The story of the Mohave read alone cannot do less than impress one with the magnitude of faunal changes and with their apparent definite trend toward the life of to-day. Related to other records, it becomes a part of the great world-scheme of life growth or evolution leading up through the ages to the present living world of which we are a part.

INSECTS OF THE PACIFIC

PROFESSOR VERNON L. KELLOGG

WHEN one speaks of the insects of the Pacific, they are the insects of the Pacific shores and Pacific islands that one refers to. For with all the amazing adaptiveness of insects to variety of habitat and habit, and with all the pressure of enormous numbers of species and individuals to drive them far and farther and into all the available places of earth, the insects have, curiously, so far not invaded the oceans. Although they constitute of known living animal kinds a full two thirds, perhaps three fourths, they are restricted in habit to but one third part of the earth's surface, to wit, its dry land and fresh and brackish waters. The real salt sea is tenantless of insects. A few long-legged surface-treading kinds are found on ocean waters far from land, but these are really inhabitants of surface sea-weed patches, which, like their fresh-water cousins, the familiar water-striders or skaters of ponds and quiet stream-pools, can run or glide quickly over the water's surface, denting but not breaking the supporting surface film.

There are also a few small kinds which haunt the beaches and rocks between tide lines for sake of the rich harvest of food thrown up by the waves. Such a kind is a little long-legged fly with atrophied wings, which lives on the headlands of the California shore in the Monterey Bay region. When the tide is out it runs actively about, looking like a small slender-bodied spider, over the rough, damp rocks between tide-times, seeking bits of organic matter thrown up by the waves that dash over the rocks at high tide. When the waters come back these odd little flies seek refuge under small silken nets they have spun across shallow depressions in the rocks. They cling desperately to the under side of the protecting silken mesh, while the great waves dash and break over them. Of course they are much of the time actually submerged in salt water. But they stand it.

Recently a similar and closely allied fly has been found on the shores of bleak South Georgia Island in the South Atlantic about 500 miles east of Patagonia. And another tide-rock fly of like habits is known from the cold and tempestuous Kerguelen Island of the South Indian Ocean.

The insects of the Pacific Islands are, however, more conspicuous by the kinds familiarly known all over our continent than by the sorts peculiar to the islands. In fact, what with the same old house-flies and blue-bottles, mosquitoes and fleas, cockroaches and bedbugs, and other familiar close companions of man, the insect fauna of a Pacific island or of the Pacific coast of America is likely to be disappointingly familiar and familiarly troublesome.

But this familiar character of the first seen and most often seen insects of the Pacific points an important moral to the student of insect distribution and of insect troubles. It is the moral of man's personal aid in the wide dissemination of insect pests. Wherever he goes, by wagon, train or ship, he carries the pests with him, colonizes them wherever he settles, and supports them in their new homes by his own presence and the presence of his domesticated animals, his quickly planted grains and vegetables, fruits and flowers.

So the casually inquisitive visitor to Pacific lands will find himself irritated by the same kind of fleas, mosquitoes, buzzing flies and biting flies, nocturnal bed-fellows, the same old croton bugs and black beetles and the rest that he knows in the east and middle west.

They have all come to California and Oregon and Washington, and gone on to the Hawaiian and Samoan and Philippine Islands, just as many of them came from Asia to Europe and Europe to the Atlantic and went on to the Mississippi Valley in earlier years. And this emigration and immigration by the side and with the aid of man accounts for a considerable and, from the economic point of view, a very important part of the Pacific insect fauna. For most of the worst insect pests of California and the rest of the Pacific coast are imported and comparatively recently imported species.

The most important single group of insects to the citrus and deciduous fruit growers of California are the scale insects (Coccidæ), small, degenerate, specialized, wax-covered and protected sap-sucking creatures, of hardly the seeming of an insect at all. The San José scale, the cottony-cushion scale, the black scale, the soft brown scale, the red orange scale, and all the rest of the scaly crew are ever threatening clouds on the fruit-grower's horizon. And he spends annually much time, energy and money in fighting back the swiftly multiplying hordes of these pests.

Now practically all of them are natives of other lands; they are man-aided immigrants into California. The San José scale, that once threatened the whole deciduous fruit interest of California, came from China about 1875. The cottony-cushion scale that similarly once threatened all the citrus orchards came from Australia about 1868. And the story of the coming, and settling, and finding the country good, of several of the other kinds is as well known.

But, fortunately, the economic entomologists have learned something to their advantage from this kind of insect immigration. They have learned deliberately to hunt for and import good bugs to fight the bad ones. For example, it was discovered that the Australian cottony-cushion scale, so dangerous a pest in this country, was not so dangerous in Australia, and this because of the active efforts made there by a certain kind of little black-and-red lady-bird beetle known as the vedalia. The

scale pest had got carried to America without its vedalia enemy, and, accordingly, found California in truth the promised land. Now what more common-sensible than deliberately to import and colonize vedalia in the California orange and lemon orchards? Which was, accordingly, done, and done easily and successfully, so that here, as in Australia, vedalia keeps the cottony-cushion scale insect within practically harmless bounds.

Naturally such a success has led to many other attempts in many other similar cases. Perhaps no other success has been so marked as the now classic first one, but much other success there has been, both on the Pacific coast and on Pacific islands, notably Hawaii, and also in the eastern states. The great fight against the imported foliage and forest tree pests of New England, the direful gipsy and brown-tail moths, is resolving itself more and more into a search for and colonizing of their natural parasites in Europe and Japan.

Another type of good bug brought to the Pacific coast by deliberate importation and carefully nursed to an effective colonization is the curious little fig-wasp, *Blastophaga*, by whose means the "caprification," *i. e.*, pollination, of figs depends, on which depends, in turn, the full size, sweetness and the nutty flavor of the best commercial figs. The fig is a hollow but fleshy receptacle with many minute flowers inside. The *Blastophaga* eggs are laid in the ovules of these flowers, and there the tiny grub (larva) lives and feeds and changes finally into a little chrysalid, and then adult. The adult male *Blastophaga* is a curious deformed wingless creature, and remains in the fig of its birth until it dies. But the female is a winged active insect that leaves its natal and cradle fig and flies to others to lay its eggs. Curiously, it can find suitable egg-laying places only in the wild or so-called capri figs and so does not leave eggs in the cultivated figs, but in walking about over their flowers it dusts them with pollen brought from the fig last visited, and thus produces the necessary cross-pollination. As the *Blastophaga* lays no eggs in the domestic figs, it is necessary to keep a few wild fig-trees growing in or near the orchard.

But not all the Pacific coast insects are excessively bad bugs or excessively good ones. Some call for attention because they are just beautiful, or singular, or of unusual habit or habitat. And these are likely to seize the interest of most of us more certainly than the pests. For, after all, our interest in nature is not primarily one of dollars and cents. It is one of curiosity and of "wanting to know."

A matter that lends California's fauna and flora a special interest to naturalists is the peculiar biogeographic situation of the state. Biologically, California is essentially a large island, shut off by barriers of actual water on one side and by hot desert and high cold mountain ranges on the other, with the ends also nearly similarly barred by desert

and mountain. This results in her showing the characteristics of an island fauna and flora, with their numerous monotypic plants and animals, unique, solitary kinds, developed in isolation and under special local conditions. California's insect fauna, therefore, includes many unique species and genera, and even a few families, not found elsewhere on this continent, not even in other neighboring states. This makes it an exceptionally happy hunting-ground for the insect-collector and systematist.

But not only does its biological isolation give an exceptional interest to its insect kinds, but its extraordinary topographic and climatic diversity introduces unusual and highly contrasted conditions in insect living and, through environmental influence, produces strange kinds of specialization of structure and habit. For example, the brave little butterflies (*Chionobas*) that live on the summits of the Sierra Nevada are bound to attract our attention, for their nearest cousins (other species of the same genus) are similar butterflies confined to the summits of the Rocky Mountains, 1,000 miles away, and Mt. Washington in New Hampshire and Mt. Katahdin in Maine, 2,000 miles farther. These lonely mountain-top butterfly kinds are good illustrations of the fact that altitude can replace latitude in distribution. And they undoubtedly owe their marooning on widely separated peaks to their neglect to follow the retreating glaciers of the close of the Great Ice time northward, remaining, instead, in these isolated alpine regions where conditions have remained practically glacial.

The California mountains, especially the Coast Range, have another especially interesting group of insect inhabitants in a curious small family of delicate, long-legged, stream-haunting flies called net-winged midges (Blypharoceridæ). Although scattered widely over the world in mountain regions, hardly more than a score of species are known, of which almost one half are peculiar to the Pacific coast. Their immature life is passed, as larva and pupa, in the swiftest and clearest of mountain streams, clinging by strong little sucking pads to the smooth rock bottom on the verge of a fall. The larvæ die if they happen into slow or stagnant water, and many of the delicate flies are torn away by the current and lost as they emerge from the pupæ. But, nevertheless, with all this restriction of life to certain narrow and dangerous conditions, the net-winged midges, like the water ouzels, near whom they domicile, maintain a successful existence to add to our interest in the mountain streams.

Another interesting group of insects, well represented in California and very sparingly elsewhere in this country or anywhere out of the tropics, is the family of termites, or white ants (Termitidæ). Indeed, out of the seven species known to occur in the United States, but one is found in the east, the other six being limited to the southwest and

Pacific coast. Three species occur in California, of which two are common and constantly met with. One (*Termopsis augusticollis*) is unusually large, and makes its communal nests in fallen pine-trees, telegraph and telephone poles and other dry wood. I have found colonies containing thousands of individuals in fallen trunks of the great trees of the Sierran forest.

Another group of interesting insects unusually well represented in California are the gall-flies (Synipidæ) which form the galls, or, better, stimulate the trees to form the galls, on oaks. Seventy species of these odd little flies have been listed for the state, and there are others in Oregon and Washington. As each species has its own special kind of gall, the oak-trees of the Pacific coast often bear a curiously variable load of "fruit" besides the acorns.

I should like to speak of some of the west-coast insects of unusual appearance or pattern, the kind that catch the eye of the most casual traveler, such as the giant, tarantula-killing, bronze-winged, blue-black Pepsis wasp, that indulges in battles-royal with the big hairy tarantulas and trap-door spiders, which themselves, though not insects, are near enough related to them to warrant mention in any account of our insect fauna. But I may not. I may not speak for them at all except to say that California will match its insects against the similar fauna of any other state for interest and opportunity for fascinating observation and profitable study.

THE PHYSIOLOGICAL ASPECTS OF CALIFORNIA FOR THE BOTANIST

By Professor GEORGE J. PEIRCE

IT is almost absurd to speak under one title of a region which forms the Pacific coast of the United States for a distance equal to that from Key West to New York, which extends from sea-level to almost three times the height of Mt. Washington and from the Pacific eastward as far as Utica lies from the Atlantic. But geography and topography merely make, with the assistance of other factors, those complexes which we call climate and soil. There are, therefore, all sorts of climate from sub-tropical to Arctic,—air which ranges from dripping to dry, water which is sweet and water which is brine, growth which is constant the year round or as regularly periodic as winter and summer in the intemperate parts of the "temperate" zone. There are districts in which the daily range in temperature is greater than the seasonal range, soil which bakes to brick and soil which blows in the breeze, and, in places, light which in amount and in composition is equaled in few other parts of the known world.

If we summarize these statements we shall see that, so far as plants are concerned, it is the condition and the amount of water in air and soil which is the most striking factor in their environment. Water is not only an indispensable food material and the medium in which all the other food materials enter the plant, but it also regulates the kind and the quantity of light which reaches the earth's surface. By so doing it regulates the prevailing temperatures also, possibly to a greater degree than many of us realize.

Water, a simple, stable compound chemically, we seldom think about, taking it for granted when we have it, grumbling when anything interferes with its supply either in quantity or convenience. The average attitude of civilized man to water is similar to his feeling about the daily newspaper. He thinks little or not at all about the labor of mind and body involved in the regular delivery of the daily paper at breakfast-time at his front door. And if he thinks of water at all, it is only liquid water, of which he demands a supply ample and safe, at his hand by the turn of a faucet. Yet this flowing water is only a small part of what he needs. The water in the pipes is but a small fraction of the total upon which not only his comfort, but also his very life depends. The water in the soil, brought thither as snow or rain, or by stream and possibly by irrigating ditch, is vastly more necessary than the water in

the pipe. The soil water, added to by rain and stream, conserved by cloud and fog, is still further preserved, for the plants which receive it into their roots, by the invisible moisture in the air. For the greater the humidity the less the evaporation from soil and living body, from plant and animal alike. Water is always present, wherever there is a living thing, because, in addition to what is taken into the living body, water is formed in the body and in every cell in which respiration is taking place. The liberation of carbon dioxide in plants and animals is but part of the chemical process which is called respiration. Along with carbon dioxide, water also is formed in the oxidation of the carbon compounds which form the bulk of our food. This is exhaled, or escapes by evaporation, with the carbon dioxide, or is carried off or used. The character of the organism and the nature of the environment determine the amount and the manner of the loss of water by the body.

These are all truths of which we become conscious on reflection, but unless contrasting environments are close together, we are not likely to become conscious of them. In the Rocky Mountains one may see the timbered slopes of one side facing the grassy slopes across the valley. On the Pacific coast, chapparal and forest cover the opposing slopes, meeting at the stream-bed and at the head of the narrow valleys between the ridges of the Coast Ranges. Not the fires of the Indians nor the clearings of the whites account for these contrasts, but rather the relations of the opposing slopes to water, its supply and its loss.

The long valley in which lies the Bay of San Francisco is bounded by ranges of mountains, mainly parallel but strikingly different on the two sides. On the western shore of the Bay, gently rising to the mountain rampart which bars the Pacific Ocean from access, forests and dense shrubby growths, chapparal, cover the still uncleared slopes. The forests are heaviest in the passes, for though the rainfall may be little or no greater there, and the run-off no less rapid, the passes are fog channels. Through these channels the ocean fogs flow, bringing moisture and saving moisture in soil and vegetation. The plants of these east and west passes are strikingly different from those of the cañons which head into the mountain barrier. In the fog channels one sees the foliage and the luxuriant growths of a humid clime: the closed cañons look dry and have drought resisting or short-lived plants except close to the streams, many of which run only for a short time after the rainy season ends. The redwood and the California nutmeg (*Torreya californica*) may be taken as types of the two localities. The difference is due to water.

In parts of the world where, over great areas, conditions are similar, and the water supply is regularly much above the minimum requirement, the dependence of plants and animals upon water is much less clear, the influence of water upon them much less evident. There can be no

greater contrast in appearance, size, texture and behavior, than is offered by the two commonest and most characteristic weeds of the two seasons, the two climates, of this region, namely miner's lettuce (*Montia perfoliata*) and tar-weed (*Hemizonia luzulaefolia*).

Miner's lettuce, so named because used in the early gold-mining days of California as a salad, grows in the rainy season, when the temperature is low, often below freezing at night, the humidity high, and the soil wet and soft. Its tender, fleshy, but not thick leaves forming a cup upon a succulent stem which is carried on small and shallow roots, are traversed by slender and simple vascular bundles, and the supporting tissues are slight and weak. Its growth is directly proportional to the available and retainable moisture, for it can hold little water against dry air. In a season of scanty rainfall miner's lettuce is short and small, presenting almost a wizened appearance, and as the dry season comes on it droops, dries and disappears.

Tar-weed, so-called because of the odor of the secretion from the glandular hairs borne on its small dry leaves and the slender woody stem and branches, is a well-rooted summer weed, occupying the grain-fields after the crop is harvested or continuing long after the native grasses are dry and dead in the caked soil, growing and blooming till the rains come to soften it and to start its successors. It reaches its best development in dry and solid soil, dry air and daily sunshine. Its consumption of water is probably not less than that of miner's lettuce, but its roots can get water and the rest of its body can hold it, in soil and air so dry that miner's lettuce would shrivel and die. Or, to express a more general truth, water determines the character of the vegetation of the succeeding seasons.

Between the plants of the desert and those growing in the spray of a waterfall one may find all gradations, not only within the limits of the state, but often within the limits of an afternoon's walk. Can one do the like elsewhere on this continent or in Europe?

From a study of these conditions there should come clarity to our conceptions of the relations of water and plants, and ultimately such an extension of our knowledge of these relations as will lead not only to clarity, but to completeness.

Water, as a clear and liquid mass, or very finely divided and greatly diluted by the air, we regard as nearly perfectly transparent, though we know that even the clearest water permits the penetration of light for only comparatively short distances beneath the surface. Cloud and fog, less finely divided water than that which we record as the humidity of the air, are far from translucent. We are beginning, as a result of studies of light in very dry air, to suspect that we have underestimated the influence of water upon the quality and the amount of light available for plants in food-manufacture and acting upon them as a stimulus to

other activities. If an effort were made, I have no doubt that a very considerable list might be made of plants known to bloom and to fruit only scantily and rarely elsewhere which fruit regularly under the stimulus of the richer and more abundant light which penetrates the dryer atmosphere of the Pacific coast. Liverworts and mosses, "shade-loving" here as elsewhere, fruit abundantly and regularly, but it should be stated that their spores do not always reach perfection because there may not be time enough between the cessation of the rains and the beginning of the really dry season for them to mature fully. But, given the necessary minimum of water in soil and air, plants will fruit, crops will come, the more abundantly the more light of suitable composition they receive. And we shall presently see that the rays of the upper half of the spectrum, the violet and the ultra-violet, the ones most absorbed by water and water vapor, whether visible or not, are the ones most stimulating to bloom and fruit. Soil fertility, light fertility, and water—these three—and the greatest of these is water.

SOCIAL LEGISLATION ON THE PACIFIC COAST

By Professor WILLIAM F. OGBURN

THE Pacific coast states represent a future empire. Nature has marked them off by natural barriers and by climate more distinctly than any other division of the United States. This fact so impressed the distinguished author of the "American Commonwealth" that he speculated upon the development of a Pacific coast type of the human race and pointed out that this region might quite naturally have been the home of a separate nation. Oregon, Washington and California are equivalent in area to France and the British Isles. Their population, however, is only four and a half million, while the population of France and the British Isles is eighty-five million. It can not safely be predicted that these far western states will ultimately hold so dense a population as these European nations; yet, undoubtedly, the future will see an immense population dwelling in these new states. The opening of the Panama Canal has most dramatically forced this fact on the attention of present inhabitants of the Pacific Coast.

Here, then, an empire is being built. To the student of science it suggests several questions. How can a state be scientifically built? What principles do the researches of political science yield? Should state-makers use the experimental method? Will a democracy, in which the common people rule, be sufficiently far-sighted and capable to utilize scientific principles in building their future state? These questions arise when one studies the experiences of the Pacific coast states in state-making. It is the purpose of this paper to present the beginings of empire-building in Washington, Oregon and California as seen through their treatment of social problems. Before such a presentation is made, the viewpoints suggested by these questions need some elaboration.

The first question is: How does political science say a state should be scientifically built? Can a state be built as scientifically as an engineer spans the East River with a suspension bridge? Political science is not as exact a science as engineering, yet it has developed sufficiently to speak definitely about the making of states. The contributions of this science to state-craft may be referred to as the theory of the state.

At the time of the declaration of independence by the American colonies, the theory of the state held that the government which governed least governed best. Organized government as then known in Europe had been achieved primarily by the strong man, as typified by

the monarch. The monarch had served the very useful purpose of welding heterogenous tribes into a more or less unified whole. Through several centuries of this type of nation-making the peoples finally broke their customs of faction and their tribal habits. They became accustomed to living in the larger nation under a common language and a common law. This type of the strong man's work was then done. Under the changed circumstances his functioning appeared to the governed as tyrannical. The idea of political liberty grew. Liberty and government seemed to form a paradox. And that government which governed least was believed to govern best.

With a government owned by the people, tyranny and government ceased to be the same thing. Government and liberty were no longer incompatible. But the idea persisted, as is usual in social evolution, long after the conditions which produced the idea had changed. It persisted perhaps somewhat longer in the United States than elsewhere because of the strong individualism developed by a nation of pioneers, conquering the wilderness in small groups with little aid from the government.

Government now appears as collective organized effort. Individuals can do little acting singly, but acting through collective organized effort undreamed-of achievements may be made. The world has hardly begun to see the possibilities of organization. Hence more government is desired. This is particularly true in modern society with its tremendous complexity and heterogeneity. This is the conception of the state from the point of view of government. How is it from the point of view of the individual and liberty? The older notions of liberty meant freedom from an overbearing government, freedom to pursue life, liberty and happiness, and especially to own property. Several years of this unrestrained liberty have resulted in liberty for some, but not for others. The socially strong and the lucky have been successful, but with their success the liberties of the socially weak and the unlucky have fared very badly. The liberties of many must therefore be protected by the government. This is what is meant by the term "social justice." Furthermore, with the conception of government as the collective organized effort of all the people, the idea of "the common good" is being emphasized more than "individual rights" and the term "social freedom" is replacing the term "liberty." Therefore, from the point of view of government and of liberty an extension of governmental functions is desired. And the advice of political science on state-building is that modern society demands a government developed beyond the narrow limits of the past to the aims of social justice and collective effort. It will be interesting to observe the developments on the Pacific coast under the light of this new theory of the state.

Perhaps the reader will argue that this new theory is, after all, only

a theory and is far from being a law of an exact science. In that case if the new states build on this new theory they will be experimenting—a method which has the high approval of science. It has often been maintained that the experimental method will forever be denied the sociologist. For how can a sociologist experiment with democracy, as, for instance, a physicist experiments in his laboratory with rays of light? It would indeed be a strange discovery, if it were found that the peoples of the Pacific coast showed a willingness to experiment with their governments and were actually doing so.

With some thinkers it is still an open question whether democracy will live. Therefore it may seem absurd to discuss the ability of the common people to build a state scientifically. Empire-builders have formerly been men like Cæsar, Napoleon, Bismarck. Can the plain citizen do it? If they can, it means that the masses must not only become aware of scientific progress, but must often be willing to look beyond present needs and strong desires to the far-removed good of a future goal. The first requirement is that they shall benefit from mistakes of the past, as, for instance, the mistakes in the building of the United States. The development of the great American republic has been remarkable, but it has been accomplished at an enormous cost. Natural resources have not been conserved. Social good has been sacrificed for individual gain. And the people are now looking back with regret at the destroyed forests, at the lost water rights, and at the enthronement of special privilege. They see large numbers of their fellow-citizens struggling against an inadequate standard of living and weighted down with poverty and ill-health and unemployment. Will the Pacific coast states benefit by the experience of the United States?

The preceding paragraphs suggest the interpretation of the social order on the Pacific coast as presented in this paper. This social order is both distinctive and novel. To see it is important because it may be a glimpse into the future of forty-five other states. The following pages will present aspects of it as seen through legislative enactments, excellent indexes of the organized efforts of its citizens. For this purpose the social legislation will be classified into four groups: changes in the form of government, labor legislation, legislation affecting women and general welfare legislation.

In governmental changes Oregon is the leader. Her priority in large governmental adaptation has given rise to the term, the Oregon system. And by the Oregon system is meant such a body of laws as the initiative and referendum, the direct primary, the direct election of senators, the recall, the corrupt practices act and the presidential preference primary. Associated with these are woman suffrage, home rule for cities and a constitutional amendment making it possible to adopt proportional representation. The Oregon system sprang from

the corruption of the nineties. The people were dissatisfied with their state legislature, and with cause. They decided to make some of the laws themselves and to have the right of rejecting any of the legislature's enactments which they chose. The initiative and referendum, making these achievements possible, were adopted in 1902. South Dakota and Utah had previously passed constitutional amendments making the initiative and referendum possible, but seem to have made little use of them. California began popular lawmaking in 1911, and Washington in 1912. Following Oregon's example, there are now nineteen states that practise direct legislation.

Oregon citizens have voted in seven elections, extending over a dozen years, on one hundred and thirty-six measures, adopting fifty-one and rejecting eighty-five. The fifty measures adopted include all the above mentioned laws of the Oregon system and, in addition, prohibition, employer's liability, three-fourths verdict in civil cases, eight hour law on public works, and the abolition of capital punishment.

All the laws so far mentioned were proposed by the people themselves through the initiative and not by the state legislature, as indeed are nearly all the measures which are voted on by the people. Among the eighty-five measures rejected are a state income tax, several single tax measures, measures making it possible to abandon the general property tax, prohibition, woman suffrage, eight hour law for women, universal eight hour law, measures providing wholesale changes in the state constitution, proportional representation, and the abolition of the senate.

Some results[1] of Oregon's experiment in direct legislation are the following. A body of excellent laws have been passed with surprisingly few mistakes. Some good measures have been defeated—also several radical measures and a number of measures of minor importance. The people are conservative as well as progressive. For the education of voters the initiative and referendum are unsurpassed. The voters take a good deal of interest in lawmaking, watching the ballot carefully for jokers and private motives. Seventy-five per cent. of those who vote, vote on the measures. All classes of citizens initiate laws. The voters amend their constitution as readily as they pass bills. The tendency is to place a larger number of measures on the ballot. The efficiency of representative legislatures seems not to have suffered, but perhaps to have gained.

The first law passed by the initiative in Oregon was the direct primary law. The direct primary, by permitting voters to vote directly for nominations, has done more than any other device to break the grip of

[1] The evidence for the above mentioned conclusions may be found in the following papers: Ogburn, "Direct Legislation in Oregon," Quarterly Publications of the American Statistical Association, June. 1914; and Montague, "The Oregon System at Work," *National Municipal Review*, April, 1914.

machine politics and to restore control to the people. Oregon was the second state to adopt the direct primary; Wisconsin, in 1903, preceded Oregon by one year. Washington followed in 1907 and California in 1909. Now there are thirty-two states possessing it, not counting the southern states that have long had the white primary. The effect of direct nominations has been to loosen party ties. Perhaps other governmental agencies have assisted, but at any rate, party ties bind very lightly on the Pacific coast. Some careful observers think that the direct primary has finished its work in Oregon and that it has left an expensive and troublesome double elective system. Hence Portland, Oregon, is found by 1913 adopting a non-party preferential system of voting that necessitates only one election and provides approximately majority rule by the counting of second and third choice votes. Washington also has a preferential system for state elections. The system is somewhat technical, but seems to have produced excellent results in the few elections in which it has been tried.

In the Oregon direct-primary law was found a curious clause known as "Statement No. 1." The operation of "Statement No. 1" resulted in the direct election of United States senators without the adoption of a constitutional amendment to that effect. "Statement No. 1" was simply a statement, which might or might not be made by a candidate for the state legislature, to the effect that he would vote in the state legislature for the people's choice for United States senator. The candidate felt that his chances of election were better if he thus pledged himself. Although a majority of the candidates "took" the statement, the fight to make it effective was dramatic. It was so successful, however, that a republican legislature was forced to elect a democrat for senator. Attention is called to "Statement No. 1" because it was a genuine invention, the rarest of phenomena in politics. Other states followed Oregon's example. All such devices lost their force, however, when the constitution of the United States was so amended that senators are no longer elected by the state legislatures, but directly by the people.

Associated in spirit with the initiative and referendum is the recall of public officials at the will of the voters before the expiration of their terms. Oregon adopted the recall in 1908, and was the first state to do so. California followed in 1911 and Washington in 1912. At the present time ten other states have the recall. The recall has precipitated much argument concerning the whims of democracy and mob psychology. However, experience shows that it has not been used very much. The most conspicuous cases are the recalls of a mayor and an occasional councilman. The failure to use it is not due to the number of signatures necessary to put it in operation, but rather to the difficulty in securing an able candidate to run against the recalled official and

the fear on the part of the recallers of the wrath of the electorate at the expense of another election. An interesting and much-discussed feature is the recall of judges. Oregon and California permit the recall of judges; but they do not seem disposed to recall them.

In the field of local government the cities have home rule. Formerly the treatment of many strictly city problems was ordered by a state legislature many miles away and composed largely of representatives from rural districts. This led inevitably to the infusion of state and national party issues into city affairs, where they obviously had no place, and to the development of "the systems," manipulations and patronage. The commission form of government is found in large cities in the three states and there is the local initiative, referendum and recall. One may also see here an example in one of the smaller towns of the city manager plan.

Several changes in governmental procedure have been suggested. Prominent is budget procedure. California, through its state board of control, has taken the lead in budget-making. In 1913 two weeks before the state legislature convened a scientific budget was presented which resulted in a saving, it is claimed, of over $2,000,000. Other states have followed and proposals of budget reform are being made in Washington and Oregon. A consolidation of the various state boards and commissions and a reorganization of the administrative departments on the model of the United States cabinet has been widely favored in Oregon and is expected soon. The program also calls for the short ballot. Oregon has voted, though unsuccessfully, for proportional representation, the abolition of the senate and a union of the legislature and the executive. The future of these latter proposals is uncertain. The record of Oregon, California and Washington in governmental changes has been one of brilliant experiment.

The greatest extension of the functions of government for social freedom is in legislation affecting the wage-earner. Policies of liberty and of individualism have not meant liberty and individuality for the wage-earner. He has been unprotected. He has borne the toll of hazard in industry and often accommodated himself to a standard of living that is far from meeting the requirements of a democracy. The field of labor is the scene of the struggle for social justice. The labor problem and the status of industry are intimately related. Industry in the west has not reached the large development of the eastern states. Hence large and acute labor situations have not given rise in the west to so urgent a need of labor legislation. Furthermore, the Pacific coast is very eager for capital to seek industrial investment within its domains. But labor legislation may raise the cost of production as compared with the competitive industry of other states. Hence care would seem necessary lest industrial development be discouraged. But should

industry be purchased at the cost of the welfare of the workers? This is the problem that often confronts the voter. How have the Pacific coast states met this dilemma?

The first modern labor laws protecting the wage-earner were those dealing with child labor. California was one of the first states to provide child-labor legislation. Such legislation was passed in 1889, amended in 1901 and greatly improved in 1907. Washington and Oregon passed excellent laws in 1903. There have been further amendments so that the laws in these three states have a general age-limit of fourteen years, prohibitions of night-work by children, compulsory school attendance and highly important provisions for adequate enforcement. Suggested improvements are to raise the general age-limits and to provide a broader foundation of education through a longer period of compulsory school attendance.

Society is very much interested in the labor laws known as employer's liability and workmen's compensation. Modern industry bears only a slight resemblance to the craft and the rural work dealt with by the common law. Modern industry is a huge machine for which there must be workmen. Every year men, like machinery, are cast on the scrap heap. Under the common law there is no adequate financial aid for widow and children or for a dragged-out life as a cripple. California, Washington and Oregon early developed laws making employers financially liable by recourse to the courts to the employees for accidents. But the courts were slow and strange to the workmen; lawyers were expensive, and a thriving insurance consumed funds. Hence workmen's compensation laws making payments definite and automatic were passed. California passed a workmen's compensation law in 1911, being the fifth state to put it into effect. Washington passed a similar law the same year, and Oregon also in 1913. At the close of 1914 there are twenty-four states thus protecting workmen. Washington and California compel employers to operate under the law, while Oregon's law is elective, the alternative being employer's liability.

Of equal consequence to workmen are occupational diseases, such as anthrax, compressed-air illness and lead poisoning. California in 1911 was the second state to put into effect a law requiring the reporting of occupational diseases, and her law has served as a model for many of the fifteen other states which now make such requirements.

Labor has also been attacking its problems without the aid of legislation, namely, through the labor union. The methods of unions have been severely criticized, perhaps more than their aims. This is to be expected because labor is on the firing line of conflict, that has for its stakes bread and butter and housing. The daily labor of workmen is rough, direct and concrete; the efforts of their organization are of the same nature. The Pacific coast has had its share of labor-union activities.

But experience shows that the more completely organized labor is, the less its violence. This is shown by the experience of England, of the excellently organized trainmen and the ill-organized I. W. W. The skilled labor on the Pacific Coast is now well-organized as compared to other states. And in Seattle, Portland, and San Francisco, organized labor is a strong force. Figures from the Bureau of Labor Statistics at Washington, D. C., show that in general organized labor draws slightly higher wages and works slightly shorter hours here than elsewhere. Similarly, the laws are favorable to organized labor.

The conditions of the unskilled and the unorganized laborers are not so favorable on the Pacific coast. This is partly due to the nature of some of the main industries such as lumbering, wheat harvesting, the raising of fruit and hops, and construction work. These industries are seasonal to a high degree and the jobs last only a short while. This means that the living conditions are of the roughest sort. As the distances are great, the laborers are peculiarly migratory. The railroad tracks are their highways and one may here see at almost any time these migratory workers walking the railroad ties, and always with blankets rolled in bundles on their backs. The blanket pictures symbolically their crude home conditions and social life. These conditions breed the I. W. W. Here is a great need for the state to extend its functions to bring a real liberty and tolerable living conditions. Much depends on the possible success of these unskilled migratory workers in organizing. So far there has been little success. Calilfornia has recently made an investigation of labor camps and has enforced better living conditions. The free public employment bureau thoroughly developed and publicly controlled would greatly help the situation. The private employment agencies of the present time are greatly criticized with reference to their private nature, the number of them, their fees, their relation to employers. What is needed is an organized labor-market with adequate machinery for finding jobs and filling vacancies. Many of the cities have free employment bureaus; but, comparatively, they are small in number, and have not been able to compete successfully with the private agencies. California has a law, in effect in 1913, which regulates the private agencies by license and bond and by returning fees under certain conditions. The situation was so bad in Washington that the people voted at the 1914 election to abolish altogether the private agencies; the measure adopted did not even provide for public bureaus. A measure providing for labor exchanges is being prepared for the Oregon legislature meeting in 1915.

The great industries of the Pacific coast are highly seasonal and there is very little dove-tailing of them. This means that in the winter months there are large numbers of unemployed. Their numbers by industries are given in the federal census. They leave their summer

camps and flock to the cities, the centers of employment bureaus. In years of business depression the unskilled worker is caught unexpectedly, as indeed is industry. In such times, large numbers of the unemployed are utterly destitute. The winters of 1913 and 1914 were times of such experience. Some relief in shelter and food was provided by the cities; also a little work which was in the nature of relief was furnished. This was done through the city and county officials and through the collective effort of the aroused civic organizations. Unemployment is a problem as difficult to solve as it is grave. The first step in diminishing unemployment is to provide an adequate system of public employment agencies. This will probably accomplish more in reducing unemployment than is commonly supposed. Another proposal is to hold over city, county and state work until the unemployed season. In the northwest there is movement to employ the unemployed at clearing land. In this region there are large areas of stump-land. If the state would furnish cheap credit to the farmer both the rural situation and the unemployed would be benefited. California has recently appointed a commission to study the causes and effects of unemployment and to report.

A number of other labor conditions have received the attention of the legislators. In the three states, labor in mines is limited to eight hours and the hours of labor on railroads are carefully regulated. They also have the eight-hour day on public works as, indeed, have twenty-three other states. Oregon has a ten-hour law for men in mills and factories. California has an important law providing one day's rest in seven. This has been on the statute books since 1893 but only recently has much attention been paid to its enforcement. The most important single general feature of labor laws is the enforcement provisions. Enforcement is being stressed more and more by the increasingly important labor bureaus of the three states, particularly in regard to the inspection of factories for unsanitary conditions and for unguarded machinery. California's Bureau of Labor Statistics has recently been very active. The hours of labor permitted women in industry are definitely restricted; this feature will be discussed in a later paragraph. The subject of old-age pensions has been little discussed. The present-day worker tends to become unfit for the pace of modern industry at a comparatively early age, at a time of life when the professional man is only reaching maturity. This forces the issue of old-age pensions. California in 1913 appointed a commission of five to investigate and report on old-age pensions. Massachusetts and Wisconsin have similar commissions.

This summary of labor legislation shows that the Pacific coast states have advanced labor legislation to a degree quite comparable with that of their governmental reforms. This policy has not been wholly approved.

The strongest criticism is concerned with the welfare of business. Business in one state may suffer from competition with business in another state if laws which affect the cost of production are unequal in the two states. Charges of this nature have been made in the Pacific coast states with reference to some businesses. It is to be observed, however, that labor legislation is rapidly spreading, thus reducing the evils of competition and lack of uniformity. For instance, in a very few years, workmen's compensation laws have spread to twenty-four states. Indeed the rapid spread of social legislation is one of the incidental demonstrations of this paper.

Of all classes of wage-earners, women most need protection. They have not learned to organize for better wages and shorter hours, and there are special obstacles to their doing so. Yet, the inroads of machinery into the home-occupations are throwing large numbers of inexperienced women into the factory and the store, a situation not suited to a policy of little government and unrestrained liberty. And when it is remembered that women are peculiarly related to the welfare of the race, the new theory of the state seems amply warranted in legislating for their welfare. The new states of the Pacific coast, in moulding their social order, have not hesitated to provide for their women citizens.

Oregon was the first state to limit extensively the hours of labor for women; in 1907, a ten-hour law was adopted. Maine and North Dakota had previously passed ten-hour laws for women, but these were for a rather limited field of occupations. Oregon's ten-hour law is famous in being the first to be declared constitutional by the supreme court of the United States. California and Washington, in 1911, adopted eight hour laws for women and remained unique in this respect until 1913, when eight-hour laws were passed in Arizona and Colorado. In 1914, a similar law was given the District of Columbia. The hours of labor of women in Oregon have been further restricted under the minimum wage law for women. This law gives the commission establishing the minimum wage the power to limit hours of labor. This has been done varyingly for the different industries.

Of recent labor legislation for women, the minimum wage laws have aroused the greatest interest. The causes necessitating the minimum wages for women are mainly these. The development of the factory and the consequent break down of home industry has forced large numbers of women to seek employment outside the home; and the large supply of women means a low wage. The supply has been unevenly distributed because of the attractions of the store and the unattractiveness of the domestic work in the private home. The situation has been further aggravated by the fact that some girls who could be partially supported by parents were willing to work at very low wages. These

marginal girls thus forced down the wages of others who were not partially supported at home. Facts showing these conditions in Oregon were determined by an investigation conducted by the Oregon branch of the consumer's league. The report claimed that "nearly three fifths of the women employed in industries in Portland receive less than $10.00 a week, which is the minimum weekly wage that ought to be offered to any self-supporting woman wage-earner in this city." Accordingly, in 1913, the Oregon Legislature passed a minimum-wage law, being the second state to do so. The law was the first, however, to be put into effect. Massachusetts had previously adopted a minimum-wage law in 1912, but was slower in putting it into effect. Oregon's law further differed from Massachusetts's in providing a penalty of a fine or prison sentence for violations. Oregon's law served as a model for the California and Washington legislatures of 1913. Nine states now have minimum wage laws for women.

The minimum wage laws of the Pacific coast states create industrial welfare commissions with the power of setting minimum wages for women. These wages are recommended by conferences called by the commission and composed of employers and employees of the particular industry and of the public, each equally represented. The wage is legally set, however, only after a public hearing. As a result of rulings by the industrial welfare commission, the employers of industry now pay all women wage-earners in Oregon at least $8.25 a week. In Portland, the only large city in Oregon, the minimum wage is $8.64 a week in manufacturing establishments and $9.25 in offices and mercantile houses. Apprentices may work at $6.00 a week. In Washington, the minimum wage has been set at $8.90 in manufacturing establishments, $10.00 in stores, and $9.00 in telephone and telegraph offices and in laundries. The Washington apprenticeship ruling is somewhat better in that it limits the number of apprentices and the length of time of apprenticeship. The variation in the minimum wages is due to the theory that the wage should be a living wage. As to the effect of the minimum wage on business, the worker and society, no official reports or investigations have been published, although such reports are expected in a few months from the industrial welfare commissions and from the national bureau of labor statistics. However, the mercantile employers of Portland in the summer of 1914 testified before the federal industrial relations commission: (1) that the number of employees whose wages were increased was twenty-two per cent. of the total number of female employees, and that the amount of such increase in relation to the total payroll of both men and women was two per cent.; (2) that "as nearly as could be ascertained, no employees were discharged"; and (3) that the general effect on business was "negligible." Perhaps the strongest criticism of this testimony being typ-

ical would relate to the number of employees discharged. In Oregon there have been a score or more of prosecutions.

The welfare of the race and of women is further protected by mothers' pension laws. These laws provide that a woman with young children whose husband is dead or incapacitated shall receive compensation if she or her children are dependent on her for support. This is a protection for the disintegrating home of modern industrial society and a protection for the children from the same influences that have necessitated the juvenile court. California, Oregon and Washington adopted such protective measures in 1913. Prior to 1913 only two states, Colorado and Illinois, had mothers' pension laws. Now they are found in nineteen states.

The most widely admitted injustice to women is connected with prostitution, especially in its commercial aspects. Recent years have seen a nation-wide vice fight. On the Pacific coast the fight has been made, particularly in the cities, through vice commissions and reform administrations; Seattle, Portland and Los Angeles being notable cases. Portland has adopted what is known as the tin-plate ordinance which provides that the name of the owner of every rooming house, apartment and hotel must be placed conspicuously on the front of the building. The purpose of the tin-plate ordinance is to fix responsibility on the owners of the buildings. Cases are known where property which ordinarily rents from \$40 to \$100 a month brings a return of \$350 a month when used for purposes of prostitution. The fact is on record that one piece of property in San Francisco costing \$8,000 brought in \$2,100 a week. The attack has mainly centered on the commercialized nature of the social evil. The unfortunate prostitute has thus yielded a large part of her earnings to the landlord, the lessee, or in some cases the organization which more or less controls her. Or she is prosecuted in the courts, and must pay a fine perhaps over and over again. The sinister aspect of the situation is that some one other than the prostitute reaps these dearly-paid-for earnings and escapes, while added suffering is meted to her. This situation explains the origin of the so-called red-light abatement laws. The abatement laws permit a judge to close any building that is used for purposes of prostitution. The building, may be opened again by giving a bond equal to the value of the building with the pledge not to allow prostitution within the building. Washington, Oregon and California have abatement laws, modeled on the recent Iowa law. The age of consent in each of these three states is eighteen years. As a result of the recent experience of the Pacific coast states, some headway has been made in fighting the sinister commercialization of prostitution.

The woman's movement in its political aspects is well developed in the west. Women may now vote in each of the three Pacific coast states.

Washington thus extended the franchise in 1910; California, in 1911; and Oregon, in 1912. Previous to 1910, four western states, Wyoming, Colorado, Utah and Idaho, had permitted women to vote. Now twelve states have extended the franchise to women. The results of this extension of the suffrage are naturally of great interest. Some statistics of the number of women voting have been collected in different places. The relative proportions of women voting to men voting vary. Taking into consideration the fact that there are more men eligible to vote than women, an approximate average would show that about three quarters as many women as men vote. Women's organizations are showing increased interest in political questions. Political speakers often find that women constitute more than half their audience. Coincident with the voting of women is the prominence given to moral issues. Prohibition and the abolition of capital punishment were voted at the 1914 election in Oregon, these measures having been previously defeated at a recent election in which only men voted. This does not prove that women carried these measures, yet the general opinion seems to favor this conclusion. Recent reform administrations in Portland and Seattle have been attributed partly to the influence of women voters. There is also evidence which points to the influence of women in bringing health and educational measures to the fore. Two members of the Oregon state legislature in 1915 are women.

There remains to be considered legislation which does not concern directly instruments of government, or laborers or women as classes; this may be called welfare legislation. This class includes such topics as taxation, public utilities, prisons, education, eugenics, the sale of liquor and immigration.

The system of revenue in nearly all the states is the general property tax. The verdict of political economists is that it is unjust and antiquated; unjust because intangible personality escapes taxation, and antiquated because adapted to the relatively simple condition of a more equal distribution of wealth found in newer communities. The general property tax is supplemented by other forms of revenue, as inheritance taxes, corporation taxes and licenses, so that some states, perhaps not more than ten, have escaped much of the evil resulting from the general property tax. Fewer than this number of states have definitely abandoned it, having separated state and local taxation. California abandoned the general property tax in 1910 and acquired the separation of state and local revenues. Oregon has on two occasions voted against proposals leading to the abandonment of the general property tax. Every election for the last few years in Oregon has brought forth a good-sized list of tax measures to be voted on; and not many of them pass. Intense interest in Oregon has centered on the single tax. The single tax as discussed in Oregon means the raising of larger proportions of revenue from land and smaller proportions from improve-

ments and industry. The single-taxers claim that the increasing values of land are made by the community and that the community should take these values through taxation. They furthermore consider the taxation of industry as a hindrance to industrial development and unjust. The single-tax measures have assumed various forms, according to the imagined taste of the voters. Three times they have been voted down; though the election returns show that they were favored by about one third of the voters of Oregon.

Street railways are the public highways of the modern city dweller, as are the streets for the inhabitant of a small town. Hence the opposition to their use for private profit and the insistence on their regulation for the welfare of the citizens who have no other recourse than to use them. The public's interest in these public utilities is further heightened by the close relationship that has existed between the governments of the cities and the officers of the public utility companies. This relationship is quite natural, but in some cases it has not worked for the best interests of the public. Hence another governmental function has been developed, that of regulating public utilities. California, Oregon and Washington in 1911 passed public utility acts modeled on the Wisconsin law, placing the control and regulation with the state railroad commission. There are a few instances of municipal ownership of street railways on the Pacific coast. Seattle began the operation of a short line in 1914. San Francisco affords the more important instance, being the first large city in the United States to own and operate a municipal street railway. The Geary Street Railway began operation as a municipal road in December, 1912, after a long fight begun in 1896. The line is five and one half miles long. Its operation has been successful and the citizens seem pleased with it. A municipally owned railway is also being run to the fair grounds of the Panama-Pacific Exposition.

In the cleaning up of prisons and the bettering of conditions of prison labor, the Pacific coast states have taken a leading place. The theory of prison reform is to turn prisoners back to society better men and women. To this end the "honor system" has developed. This means that prisoners are permitted to work at their various occupations with no armed guard, bound only by their pledge of honor. Published reports state that there are no more escapes than under the old system. The "honor system" has been developed in Nevada, Colorado and in a few prisons in Ohio and in New York; but Oregon is notable in having proportionately more prisoners working without guard. The "honor system" is more spectacular, but no more important than other features of prison reform, such as farm colonies, treatment of female prisoners, medical aid, manual training shops and the parole system. Progress in these features has been especially marked in California during the last three years. The private leasing of convicts by contract and the

inhuman situation which often develops therefrom have been prohibited in Washington, Oregon and California. Washington and Oregon in 1912 and in 1914, respectively, abolished the death penalty.

It was long ago realized that public schools are foundation stones of efficient democracy. Their maintenace was one of the first extensions of the government's functions. All the states now have them. The modern social movement is concerned with perfecting the already accepted system. The efficiency of the public school systems of the forty-eight states was recently investigated by the Russell Sage Foundation and a comparative study published in 1912. The measurements of efficiency were based on the following features; children in school, school plant, expense per child, school days per child, school year, attendance, expenditure and wealth, daily cost, high schools, salaries. Ranked according to these standards, Washington stood first of all the states, California fourth and Oregon fifteenth. California and Washington furnish free text-books to the public school children.

In the new science of eugenics, California is one of six states to require the sterilization of such unfit as the confirmed criminals, insane and feeble-minded, who are in institutions. Unfortunately, there are only a few of the feeble-minded confined to institutions. The Oregon legislature passed in 1913 a sterilization measure which was, however, referred to the people and defeated. The sterilization laws are similar to the Indiana law, which provides for a rather novel and simple operation which prevents the conception of offspring and thus safeguards society against the transmission of socially undesirable hereditary traits. These laws have sometimes fared badly with the courts and the changing governors. Oregon requires that the applicant for a marriage license shall present a certificate from a physician stating that he is free from venereal disease.

Oregon and Washington in 1914 voted in favor of prohibiting the sale and manufacture of liquor, making the total number of prohibition states fourteen. In the same year California voted on prohibition, but the measure failed to carry. California, however, has local option.

Immigration is a very serious matter for the Pacific coast states at the present time. Yet little has been done to receive the possibly large number of immigrants who may come and to prevent them from breaking wage scales, from congesting the cities and from developing bad housing conditions. The trade unions of the Pacific coast have held a convention on the subject. The most important step has been taken by California in creating a commission on immigration and housing, with a paid secretary and an annual budget. This commission has made a survey showing the status of housing, the living conditions of labor camps, and the methods of the various exploiters of immigrants. As a result of this survey, it is recommended that the state tenement house Act of 1911 be more strictly enforced, that the commission be given the

power to license lodging houses used by immigrants, and that health and sanitation rules be more strictly enforced in the labor camps.

In making this brief survey of the experience of the Pacific coast states in state-building, the author has no doubt omitted several important features. Such omissions, with the exception of two, have been made because it was thought best to include only those features in which the Pacific coast states were somewhat distinctive. The two omissions just referred to are the rural problem and the development of business. These are important, but are without the limits of this paper.

The conclusions of this paper show that in empire-building citizens of a democracy have not hesitated to build according to the new theory of the state as set forth by the researches of political science, a theory that demands a government strongly and widely developed for the aims of social justice and collective effort. These new states have shown efficiency and built with dispatch. Government as collective organization and effort has been excellently demonstrated. The unrestrained liberty which has meant injustice to others or to the group has in many ways been restrained, and the forgotten rights of the unprotected have not been neglected. The new states have not hesitated to experiment. It is well to see these experiments in summary. Oregon was the first state to adopt the recall, the direct election of senators, the presidential preference primary, to pass an extensive ten-hour law for women and to put into effect the minimum wage law for women. California and Washington were first to adopt the eight-hour law for women. California was the first state in scientific budget making. Washington was first to abolish private employment bureaus and is first in the efficiency of public schools. Oregon was third to provide for the initiative and the referendum and was first to develop them. Oregon was second to adopt the direct primary and California was second to put into effect a law requiring the reporting of industrial diseases. There were only two states to precede the Pacific coast states in creating mothers' pensions. In adopting other social legislation, while not the first, second or third states, Washington, Oregon and California were in a small leading group to legislate effectively on home rule for cities, child labor, hours of labor on public works, factory sanitation and inspection, employer's liability, eugenics, prohibition, prison reform, public utilities, municipal ownership, the social evil and woman suffrage. The success of these experiments may be interpreted by observing the extent to which other states are following their example. To see the new social order of the Pacific coast, social legislation should be looked at in its entirety. This social order is distinctive. No other group of states possesses such a wealth of social legislation. This paper has aggregated the variety of cases found among these Pacific coast states and it is a very imposing picture that is revealed.

THE VOLCANIC ACTIVITY OF LASSEN PEAK, CALIFORNIA

By Professor RULIFF S. HOLWAY

NOTWITHSTANDING vague reports of early settlers it now seems practically certain that no white man had witnessed an eruption of a volcano within the limits of California until May 30, 1914. On that day Lassen Peak, a well-known old volcanic cone in the northern part of the state situated about seventy-five miles southeasterly from Mt. Shasta, suddenly burst into explosive action. During the six months that have elapsed since the first eruption took place, including one quiescent period of twenty-three days, there has been an average of one eruption every three days with no indication at the time of writing that the activity has ceased. The uniqueness of the phenomena as part of the physiographic processes of the United States[1] invites some detailed description for several reasons.

A natural curiosity exists concerning the events which have actually occurred and also as to the most probable developments in the future. Is this recent activity a sign of the rejuvenation of a long quiescent volcano which is once more to pour forth its floods of lava? Or are the outbursts merely the last relatively feeble, but convulsive efforts preceding the final extinction of the subterranean forces that formerly built up the old lava cone still after centuries of erosion towering nearly two miles above the level of the sea? As yet reliable forecasts of volcanic activity are not made on a scientific basis, but it is hoped that the following pages will at least give a satisfactory outline of the history of the region up to the present writing.

Lassen Peak stands in the southeastern part of Shasta County, nearly two hundred miles from San Francisco. According to the Lassen Peak topographic sheet (a reconnaissance map surveyed in 1882–84, see Fig. 1), the mountain is ten thousand four hundred and thirty-seven feet in elevation and is approximately in latitude 40° 30′ N. and longitude 121° 30′ W. The immediate region is the extreme southern portion of that great tertiary lava flow some two hundred and fifty thousand square miles in extent, covering not only northeastern California but portions of Oregon, Washington, Idaho and Nevada as well.

[1] Volcanic eruptions in Washington have been reported but apparently never studied at close range. Professor George Davidson reports seeing Mt. Baker in eruption in 1854 and in 1870. *Pacific Coast Pilot U. S. G. S., 1899.* J. C. Fremont in his journal under date November 13, 1843, writes as follows: "At this time two of the great snowy cones, Mount Regnier and St. Helens were in action. On the 23 of the preceding November, St. Helens had scattered its ashes, like a light fall of snow over the Dalles of the Columbia, 50 miles distant." *The Exploring Expedition. D. Appleton & Co., 1846.*

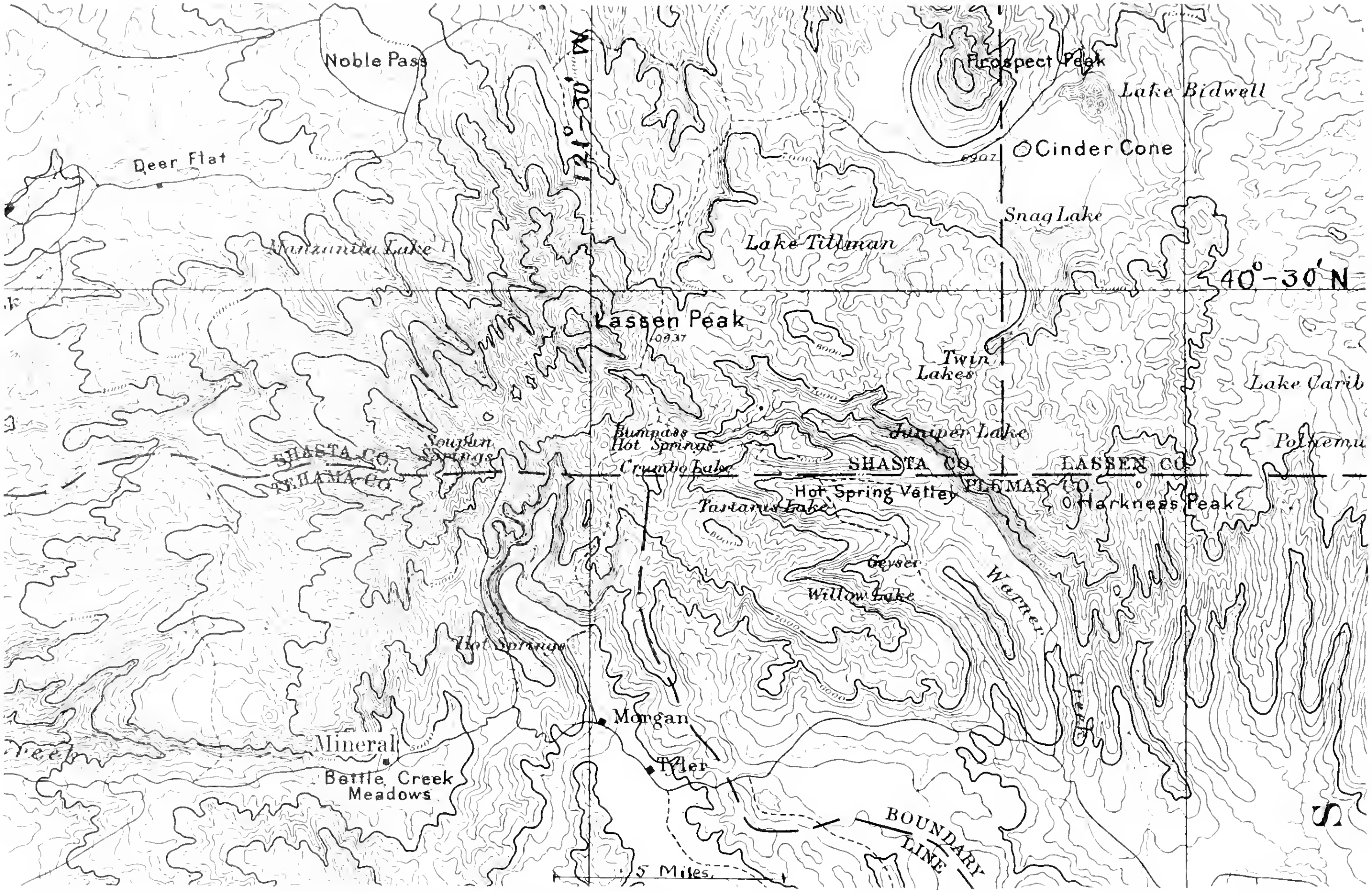


FIG. 1. LASSEN PEAK AND VICINITY. The area shown is the central portion of the Lassen Peak sheet of the U. S. Geological Survey. The quadrangle was surveyed in 1882-84. As reproduced here the scale is practically four miles to the inch.

In general, geographers consider Lassen Peak as marking approximately the southern end of the Cascade Range, and as being the last of that series of great volcanic cones of which Rainier, Adams, Hood, Three Sisters, Mazama, Pit and Shasta are familiar examples. To the southeast of Lassen the topographic gap of the Feather River separates the Cascade Range from its correlative, the Sierra Nevada, which extends four hundred miles farther to Tehachapi Pass, but whose lofty peaks owe their height primarily to uplift rather than to volcanic upbuilding.

The southern fifty miles of the Cascade Range extending northwesterly toward Shasta from the North Fork of the Feather River is a great volcanic ridge, about twenty-five miles wide. This ridge is studded with numerous minor volcanic cones culminating in Lassen, the dominating peak, which is guarded by a number of other major cones rising to heights varying from seven thousand to nine thousand feet above the sea. Past volcanic phenomena of the Lassen Peak region in recent geologic time have been made familiar to readers through J. S. Diller's well-known report,[2] which describes with considerable detail the Cinder Cone, ten miles northeasterly from the main peak, from the base of which the latest lava flow issued. Until the present outbreak, despite our knowledge of the Cinder Cone lava flows, it has been tacitly assumed in physiographic literature that Lassen Peak belonged to the class of extinct volcanoes, although the following statement by Diller in the folio just quoted shows clearly that twenty years ago he did not consider the volcano entirely extinct.

> The latest volcanic eruption in the Lassen Peak district, and possibly the latest in the United States south of Alaska, occured at the Cinder Cone about two hundred years ago. Some of the trees killed at the time are still standing. The lava, although very viscous, spread more than a mile from the vent and formed a huge tabular pile which extends across a little valley. The lava dam thus formed developed Snag Lake, which contained stumps of some of the trees drowned at the time the lake originated.
>
> That volcanic activity is not yet extinct in the Lassen Peak district is shown by the presence of numerous solfataras and hot springs. At Bumpass's Hell, near the southern base of the peak, there are boiling mud pools and vigorous, solfataric action. Near by, at the head of Mill Creek, the sulphur deposited by such action is so abundant that attempts have been made to mine it. Similar phenomena occur in Hot Springs Valley and at Lake Tartarus and the Geyser, near Willow Lake. The Geyser is much less vigorous than formerly, and now the column of water rises scarcely a foot above its pool.

Previous to the present activity of Lassen Peak there had been numerous indefinite reports of eruptions witnessed by the Indians in that vicinity shortly before the coming of the white settlers. The most definite of these reports is given in a recent letter from Dr. J. W. Hudson, of Ukiah, California.

[2] Lassen Peak Folio, U. S. Geol. Survey, 1894.

I was in that region in 1904 collecting for Field Museum of Natural History, Chicago, department anthropology, and heard much of Lassen Butte. An old Indian told me that when a child and living some sixteen miles northwest of Cinder Cone, there came an earthquake at Lassen one summer day. The sun arose, but gradually faded to the darkest night and ashes came down like a heavy snowfall. Its weight finally broke in the bark houses and the natives rushed out into the darkness. The boy was taken by a grandmother to a hollow pine log where they remained till nearly famished. When the sun reappeared he was carried many miles before drinkable water was found. I presumed at that time my informant was near seventy years old and about six on the above occasion, thus approximating the date 1850 for this eruption. In many localities along the Pit river water shed I heard similar reports amongst the aged Indians. The name of this volcano in Palainihan tongue is "Am blü'-kai" "Mountain ripped apart."

The region about Lassen Peak for many miles is very rugged, the few valleys suitable for agriculture lying at an elevation of from 5,000 to 7,000 feet. Naturally it is sparsely settled, and this year, on the date of the first eruption, the snow was still very deep, obscuring all roads and trails down to the six-thousand-foot level. On account of the unusually late season, the summer influx of cattlemen, lumbermen and campers had not yet begun; probably the nearest occupied house was at least eight miles distant from the mountain top.

Prompt investigation of the first eruption is due to the fortunate fact that the mountain is included in the Lassen Peak National Forest and that the United States Forest Service[3] had built a fire look-out station on the topmost crag of Lassen Peak itself. The summer headquarters of the forest supervisor, Mr. W. J. Rushing, are in Battle Creek Meadows, near Mineral postoffice, a little more than ten miles in an air line from the top of the mountain. The look-out house on Lassen and the other stations also are connected with the supervisor's headquarters by the government telephone lines which extend to the town of Red Bluff, nearly fifty miles to the westward, giving direct communication with San Francisco. When the eruptions began the fire look-out station on Lassen had not yet been occupied for the summer season of 1914, but it was the property of the Forest Service and a station of importance. It will be seen then that the interests and resources of the Forestry Service as indicated above were such that reports of volcanic activity on Lassen were investigated at once and definite records kept of the reports brought in to headquarters.

The following extracts are from the report of Forest Supervisor W. J. Rushing to the District Forester at San Francisco, made June 9.

Such wild stories are being circulated concerning Mt. Lassen that I am

[3] The writer wishes to express his appreciation of the assistance and courtesies extended him in connection with his field work not only by District Forester DuBois, of San Francisco, and Supervisor Rushing, of Mineral, but also by various members of the staff in each place.

sending you the results of our observations to date. Saturday, May 30, the first outbreak occurred at 5 P.M. This was witnessed by Bert McKenzie, of Chester, who was looking directly at it when it occurred. Ranger Harvey Abbey investigated it on Sunday, May 31, finding a hole 25 x 40 feet in size and of unknown depth. Sand, rocks as large as a sack of flour, and mud had been ejected. The heavier material was thrown over an area three hundred feet across, while the ash, or cement-like material, was scattered over an area one quarter mile across. . . . No molten material was thrown out at all. 8:05 A.M., June 1, a second outburst occurred, throwing out large quantities of the same material. Some boulders weighing all of a ton were thrown out. The vent was enlarged to 60 x 275 feet. . . . Boerker, Abbey, and Macomber went up June 4, remained on top at the lookout house over night, and came back June 5.

June 8, heavier volumes of steam were noted, and at night apparently another eruption took place, throwing out more ashes or fine material, which could be seen on the new snow.

Heavy volumes of steam are coming out of the vent today. We have watched it carefully and at no time have we been able to see any flame or indication of fire. . . . The vent is about one quarter mile from the fire lookout house, and if it continues eastward, as it has so far, it will finally break out on the east side.

Mr. Ben Macomber, one of the party mentioned in the report above as spending the night on the mountain top, has given the following description of the crater as it was after the early eruptions:

When I saw the new crater on Lassen on June 4 and 5, the vent, by an engineer's tape, measured 275 feet long. It was then in one of the pauses between the heavy explosions. Thick volumes of steam, laden with sulphur smoke, were rising, and cracks were appearing in the ground. From three different places on the edge I looked down into the crater. Sixty or seventy feet down a pile of rocks was visible in the center of the vent, but at either end was a huge dark hole from which the steam clouds poured. The walls were absolutely perpendicular, and around the top were hung with huge icicles formed by the condensation of steam in the chill air of the peak.

On the west side of the crater everything was buried beneath a heavy fall of light gray ash, into which we sank over our boot-tops. So light was this rock powder that it flew into the air at every step. On the east side the same material seemed to have been thrown out in the form of mud and lay frozen hard as rock. What little snow remained near the crater was buried under a layer of stones and boulders. (San Francisco Chronicle, June 28.)

The eruption of June 14 was heavier than any which had preceded it, and the only serious injuries suffered by visitors during the six months covered by this article, occurred during the outburst beginning at 9:45 A.M. Extracts from a letter from Mr. B. F. Loomis written a month after the events gives a brief summary of the experiences of the party that was caught by this eruption, as told to him by the different members.

Mr. Phelp's party had just reached the rim of the old crater and sat down to rest a short time, watching the smoke from the crater, when the eruption began. Without any warning or explosion that could be heard, a huge column of black smoke shot upward with a roar, such as would be caused by a rushing mighty wind, and in an instant the air was filled with smoke, ashes and flying rocks

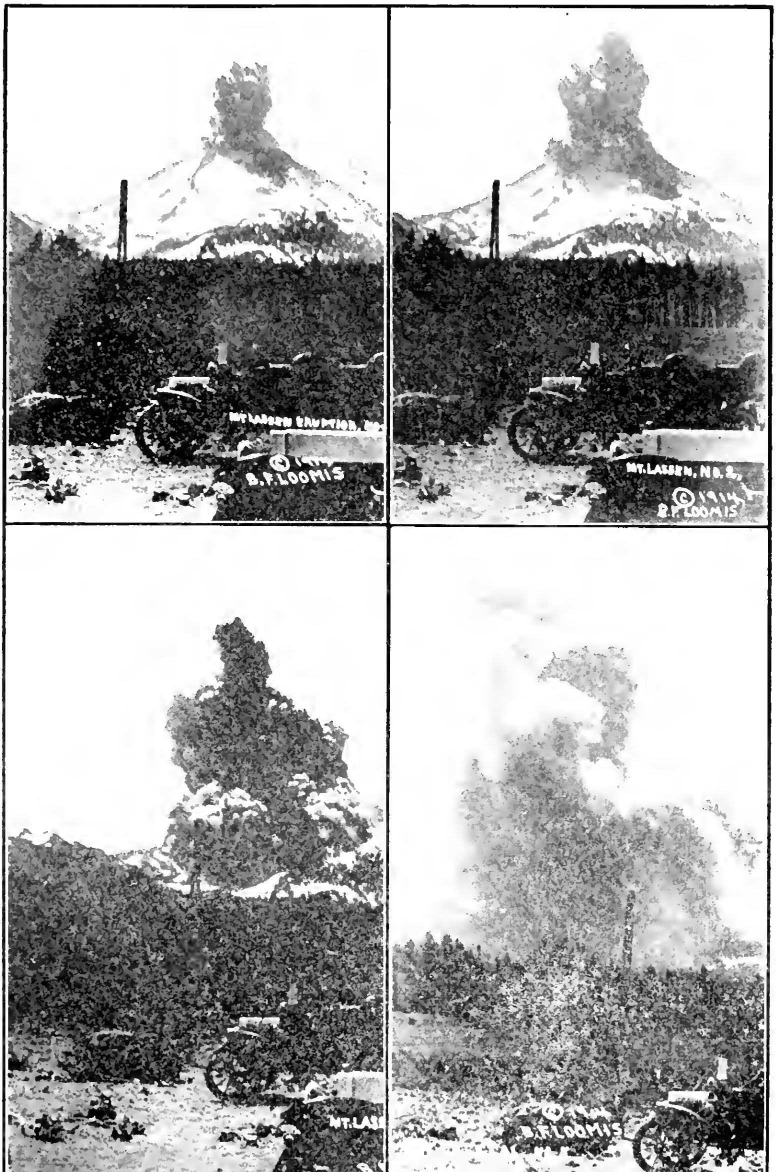


FIG. 2 THE ERUPTION OF JUNE 14, 1914 This series, showing four stages in the eruption beginning at 9:45 a. m., was obtained by Mr. B. F. Loomis, of Viola, from a point about six miles to the northwest at an elevation of nearly 5,000 feet. The time interval represented by the four views of the plate is about fifteen minutes.

from the crater. They all ran for their lives. Mr. Phelps hid under an overhanging rock, which sheltered him from the rocks which brushed past him as they fell. Lance Graham was a few feet away and was struck by a flying rock, which cut a great gash in his shoulder, piercing the thoracic cavity, and broke his collarbone. He was left on the mountain for dead for a time, but was afterward removed with great difficulty, and is now recovered. Another of their party ran down the mountain and, coming to a snowdrift, slid down the mountain like a shot. The cloud of smoke kept pace with him, and when he reached the bottom of the snowdrift he found a clump of bushes and, diving into it, buried his face in the snow to keep out the blinding smoke and ashes. The smoke is described as causing the blackest darkness, black as the darkest night.

The six photographs taken of this eruption by Mr. Loomis from a point at an elevation of about 5,000 feet and nearly six miles to the northwest of Lassen Peak are among the best that have been taken. The view reproduced in figure 2 is number three of the series and shows the steam and ash at about one half the height to which they were projected some ten or fifteen minutes later.

The writer's first trip to the mountain since the eruptions began was made by the Southern Pacific railroad to Red Bluff, thence by stage to Morgan Springs, a resort nine miles southerly in an air line from the peak and located in a valley nearly 5,000 feet above the sea. The week from June 21 to 28 during which no eruption occurred was spent on the mountain or at its base. Some of the hot springs and solfataras at the base of Lassen Peak were visited on the twenty-first and found to exhibit no unusual activity (see Figs. 7 and 8). From June 23 to 25, rainstorms, with snow on the higher levels, prevented a visit to the crater, with any possibility of photographic work. On the twenty-sixth, and the twenty-eighth, the sky was clear, and the new crater was visited and photographed from various points of view. Both trips were made from the hotel at Morgan as a base. The ride on horseback to the foot of the volcanic cone proper at that time took almost four hours, the latter half being over snow from ten to twenty feet deep. After leaving the horses the climb to the top can be made in less than an hour. The new crater has frequently been described as being located on the south slope of the north peak; this peak, however, is merely a fragment of the northern portion of the walls of the ancient crater. The relations of the new opening to the old volcano are better appreciated by describing it as an opening not in the center, but on the north side of the much eroded bowl of the crater. The central depression of the old crater is probably over three hundred feet below the higher points of the old rim. The wall of the old crater has been deeply breached both on the east and on the west, and in summer the melting snow in the depression now drains westward, although there is not enough surface water to make any regular channel. Volcanic dust or "ash" from the different eruptions has been reported as falling from ten to twenty miles from the peak, the amount and direction varying with the wind.

The limit of the heavy fall of ash not wind-borne was quite definitely marked on June 26 and was probably within a circle of less than a mile. It had not, however, a uniform border. In making the ascent on that day, instead of the regular trail a more easterly route was taken, leading up the southeasterly ridge directly to the fire lookout station. This ridge, which lies in the general direction of the longitudinal opening of the crater itself, was found to be much more heavily covered with ash than the regular trail. While the main outbursts were usually directly upward in the eruption described, irregular streaks of ash such as the one just noted prove that there were minor outshoots of volcanic dust in various directions. Exaggerated reports of the distance to which stones were thrown seem to have been based upon their being

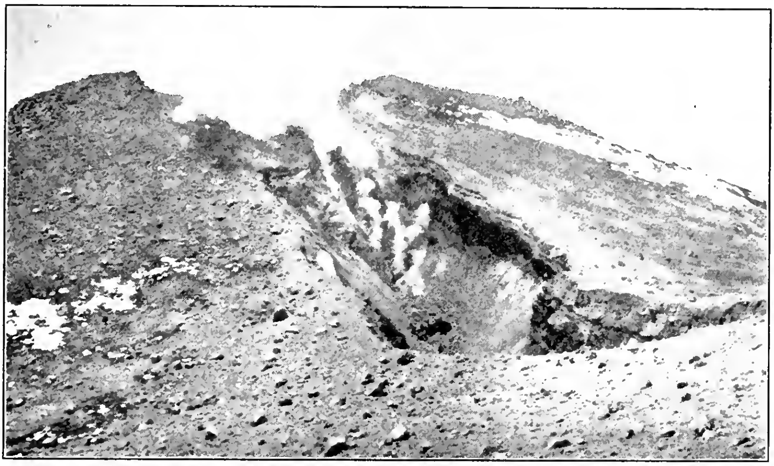


FIG. 3. THE NORTHWESTERLY END OF THE CRATER ON JUNE 28. Whenever the steam was blown aside, a crack was visible extending in the line of steam jets.

found on the outer slopes of the old crater resting upon the surface of the snow, but the fact that stones are constantly being dislodged from the cliffs by ordinary weathering processes and are rolling down the mountain side shows the need of additional criteria. To avoid mistaking such stones for those thrown through the air by eruption, careful search was made on level patches of the old snow so located that it was impossible for stones to roll down upon them. Wherever such level surfaces were found there was no evidence at that time of ejected stones falling at a much greater distance than to the lookout house, certainly at no point over a half mile from the crater.

In climbing Lassen Peak from the southeast up to the crag upon which the Forest Service station is built the slope is so steep and rugged that the final ascent is made without any glimpse of what is ahead. As the last rocks are scaled and one stands on the wind-swept crag by the fragments of the little frame building once bound down to the rocks by

wire cables there suddenly yawns below the climber the bowl of the ancient crater, and he looks directly into the irregular naked chasm of the new vent torn in the opposite slope (Fig. 3). It is impossible for a camera with its narrow field of view to give correct impressions of the conditions of the mountain top. The observer standing upon that solitary, sharp, rocky pinnacle, although he narrows his vision to the new crater steaming below, is conscious of the steep slopes behind him and he also sees subconsciously the surrounding ragged edge of the bowl of the ancient crater.

Descending into the irregular basin, the new vent was photographed at closer range from various directions. No appreciable change occurred between June 26 and June 28, except the rapid disappearance of the new snow as a result of the warmer weather. The northwesterly end of the new crater (Fig. 2) was of most interest because of escaping steam. On close approach, the sulphur fumes became oppressive and yellow sulphur deposits near the vents were distinctly noticeable. The crater was apparently being extended longitudinally along cracks at either end. The northern wall showed also a transverse crack running back from the vent more than a hundred feet. The depth of the crater did not seem to be over eighty feet, but the continually caving sides suggested that the present bottom is but piled up debris. No suggestion could be obtained of the depth of the holes from which steam was escaping. By pacing a line parallel to the side and some fifty feet distant the length of the crater on June 28 was estimated at somewhat more than four hundred feet. This estimate is less than that given by some observers, but agrees closely with that made by Mr. Diller on June 20.

During the last week in July the writer again spent several days at the base of Lassen, this time approaching the mountain by the Susanville auto road which terminates at Drakesbad, a resort in Hot Springs Valley at the southeastern base of the peak. Unfortunately, the time of the second visit proved to be a period of quiescence, as had the first. In the month since the previous visit thirteen eruptions had taken place, the one on July 18 being reported by the Forest Service as "by far the most violent eruption to date. Ash, steam, etc., arose to a height of 11,000 feet. Duration practically the entire morning." Newspaper accounts of this eruption stated that the crater had been greatly enlarged yet the writer's photographs of July 25 compared with those taken June 26, with the same camera and from the same viewpoint were strikingly similar at first glance. Careful comparison indicated a lengthening of the crater of from forty to sixty feet and a proportionate widening, but the general shape and appearance were similar. The linear extension of the crater was evidently along the same crack marked by the steam jets in the June photograph (Fig. 3), and a sharp

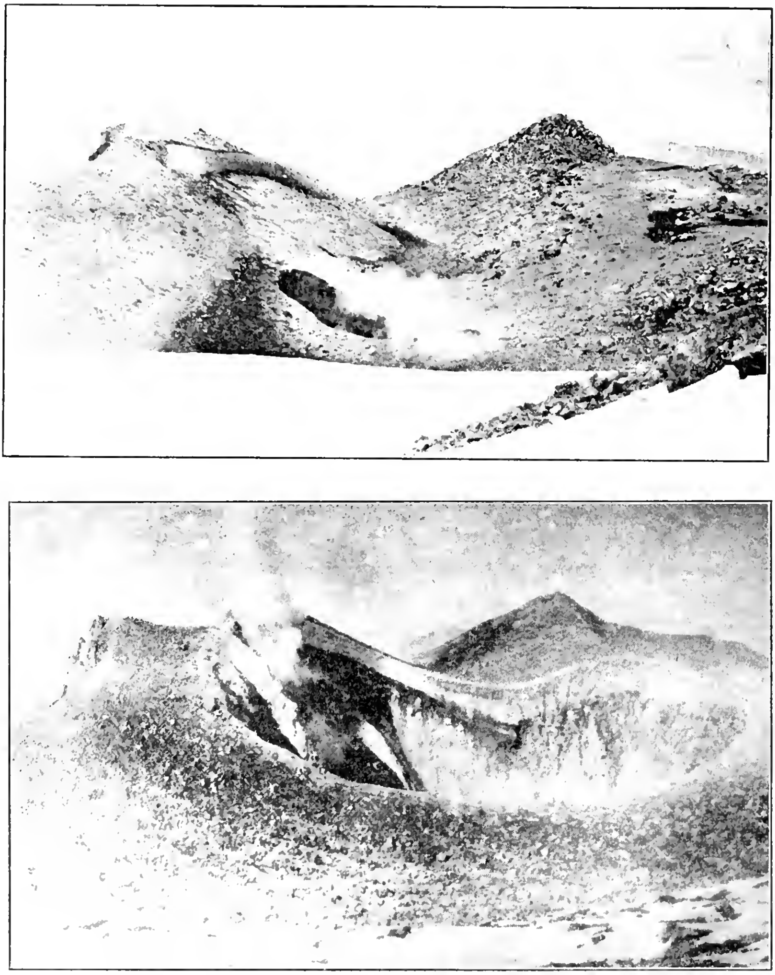


FIG. 4. GRADUAL ENLARGEMENT OF THE FIRST CRATER DEVELOPED ON LASSEN PEAK DURING THE ERUPTIONS OF 1914. *(a)* (above) the new crater on June 4, 1914. Photograph by R. H. Boerker. (Below) *(b)* the crater on July 25, 1914.

notch in the northern end suggested that the movement was likely to continue.

The winter's snow had largely disappeared, although the trail still passed over deep snow banks for nearly a mile in crossing the plateau-like shoulder at the south base of the peak proper. Near the top of the mountain snow was to be found only in patches and beneath the covering of ashes. Such areas moist from the melting snow, from a distance appeared almost black in comparison with the light gray of the dry dust found over the greater part of the mountain. This dust was so fine that it was easily moved by the wind. At times a strong gust would send immense clouds into the air, giving the appearance of an

eruption to casual observers at a distance. With the intense sunshine of a July day at that elevation and with the dry air marked differences in temperature occurred between sunlight and shadow and between wet and dry areas. Under these circumstances strong whirlwinds developed at intervals which sent the dust high into the air in columns strongly resembling steam jets. In fact, the writer when within two miles of the peak on July 25 for a time mistook them for new steam vents, all the more readily since they were situated along the line of reported extensions of the crater. Actual inspection of the area showed the real character of the columns and also that no new vents had been formed in that locality. Probably several of the incorrect reports of eruptions and of new craters came from the same failure to distinguish wind-formed dust clouds from steam explosions.

During the month of August there were but eight eruptions, fewer than either of the preceding months, and seven of the eight, all quite severe occurred August 19–23, inclusive, two of them throwing ash columns to a height of over 10,000 feet. The record for September shows seventeen eruptions, the largest number for any of the six months covered by the tabular list. During the month there was a continuous enlargement of the vent within the basin of the old crater and there were also new vents opened (see Fig. 1) on the outer slopes of the main cone. These vents are clearly identified from photographs taken by Mr. Jack Robertson of Oakland as being in line with the main axis of the first opening. Mr. Robertson had an interesting experience. He was at Drakesbad on the evening of September 19 when he heard a "tremendous explosion" during the night. The next morning he climbed the mountain and had the good fortune to watch at close range the eruption beginning at 11:30 A.M. (eruption no. 46) without receiving any serious injury. The crater was belching smoke at short intervals every few minutes and while he was quite near, steam and ashes poured out from its entire length. The ashes were so hot that they burned his feet as he walked over them. He reports having heard the roar and rumble of the explosions, but was not conscious of any apparent quaking of the ground.

The most marked changes in the new crater since the middle of June occurred during the month of September. The inner vent is reported to have grown to 900 feet in length and photographs taken early in October show that the area of the opening had become fully five times its area at the end of June. The severity of the September eruptions is also attested by the fact the lookout house (Fig. 5 and 6) was completely demolished on the twenty-ninth, no part of the walls being left standing. During the same eruption the forest lookout on Turner Mountain distinctly saw luminous bodies thrown out which appeared to him to be red-hot stones. This report is con-

FIG. 5. THE FIRE LOOKOUT STATION OF THE U. S. FOREST SERVICE ON JUNE 26, 1914. The holes in the roof were probably made during the eruption of June 14. The house has been entirely destroyed by later eruptions.

firmed by other observers, some of whom declare they saw flames. So far as known to the writer, this is the only reliable observation during these eruptions which may possibly be interpreted as indicating that there has ever been an approach to the temperature of molten lava. The coming of winter with frequent snowstorms at that elevation has prevented any search for ejected rocks bearing any evidence of recent subjection to great heat, and consequently the character of the luminous bodies remains undetermined.

The maximum severity for the entire period apparently occurred in September, but this is uncertain, since the record for October and No-

FIG. 6. THE LOOKOUT STATION AS SEEN ON OCTOBER 7.

vember is doubtless far from complete—the region extending from 15 to 20 miles around the mountain being almost if not entirely deserted by the last of October. The resort at Drakesbad at the southeastern base of the mountain closed for the season on September 21 and the headquarters of the forest service were removed to Red Bluff on October 12. The houses on the stock ranches in the vicinity are also deserted during the winter and the few wagon roads are blocked by deep snow until late in spring. Under the conditions indicated, the fact that October and November together are credited with but sixteen recorded eruptions furnishes no basis for any inference that volcanic activity on Lassen Peak is decreasing. At the date of reading proof the activity continues. A dispatch published in the *San Francisco Chronicle*, January 23, 1915, describes an eruption from a new crater on the east as equal to any which have gone before. The dispatch adds that no one has visited the volcano's summit for over two months.

An interesting suggestion concerning the November record comes in a private letter from Mr. Rushing. The eruptions from the summit which were observed during November were all ranked as medium in severity. The suggestion is that this may be explained by the fact that a new vent has been opened at a much lower level. The eruption of November 18 as seen by two observers at stations situated north of west from Lassen came from a point on the north slope of the mountain about a mile from the top and presumably near timber line. A comparison of distant observations from the north and from the south may soon test the correctness of this supposition.

Some further idea of the magnitude of the eruptions of Lassen Peak may be gained from the record of distant observers. A letter from Professor Charles F. Shaw, who was at Amadee about 65 miles eastward from Lassen Peak on October 23, contains particularly interesting observations. The eruption began at 5:40 P.M. The mountain showed plainly over the tops of the nearer hills and the smoke of the eruption was clearly silhouetted against the western sky, extending directly upward from the peak.

The smoke rolled up until practically the entire height [12,000 ft.; see list of eruptions] was reached before any change in form occurred, when just below the top of the column there was a tendency to stratification and a layer extended out toward the south and toward the north. When this appeared, the smoke column began to lean toward the north and from our point of vision, apparently toward the northeast and with this inclination of the column, distortion took place, the upper part spreading out into streamers. As soon as the inclination of the smoke column became very plain, we could readily distinguish indications of falling material. The lower two thirds of the column seemed to be dropping some material that was falling in a slightly oblique line, the obliqueness pointing back toward the mountain peak. As the eruption continued and the smoke column blew out more toward the north, the streaked condition indicating falling material became more and more apparent, but as the light was failing it became rather hard to distinguish the exact outlines of the lower portion of the column.

FIG. 7. SOUPAN SPRINGS SOUTHWEST OF LASSEN PEAK.

The falling matter must have been the stones and coarser material in distinction from the fine ash forming the top of the column of smoke. Professor Shaw's observation is the only one received by the writer that indicates the height to which the heavier fragments were thrown. "Two thirds" of the column would indicate a height of 8,000 feet.

There seems to be entire agreement by all the competent observers who were fortunately situated that in none of the eruptions has there been any molten lava emitted. Sunset glow upon the steam clouds has most probably accounted for some of the "flames" reported to the newspapers. Samples of the ash were submitted to Professor A. S. Eakle, of the Mineralogy Department of the University of California, and his report follows.

FIG. 8. TARTARUS LAKE (BOILING LAKE) IN HOT SPRING VALLEY.

An examination of the dust from the volcanic eruption of Mt. Lassen shows it to be made up of fine dust and broken fragments of an acid volcanic rock which has been shattered to pieces by a violent explosion. Under the microscope there are to be seen many small angular fragments of quartz, pieces of triclinic feldspar showing twinning structure, perhaps oligoclase in composition frayed sections of brown biotite and grains of magnetite. The original rock could not have been more basic than a dacite and the presence of so much quartz rather suggests a rhyolite. The dust is not an ash in the sense of being a fine residual product of a cinder and there is no evidence of its having come from the cooling of a molten mass. The original rock seems from the appearance of the largest fragments to have been a volcanic tuff formed at some previous activity of the volcano, and the late eruption has simply blown this tuff to dust.

The eruptions of Mt. Lassen while volcanic in their general classification are in the same category as geyser eruptions the difference existing mainly in the fact that the explosions of pent-up steam are so violent as to shatter and throw rock debris in the form of boulders and dust. It is a question whether the explosions are very deep seated.

Some of the mud from the locality is of the same nature as the dust and probably formed from it.

Numerous inquiries have come to the writer as to whether the eruptions of Lassen Peak are to be considered as truly volcanic, and Professor Eakle indirectly raises the same point. This is naturally a question of definition merely. A volcano is primarily an opening in the ground from which the internal forces of the earth project various materials, molten rock being an essential product *at some period* in the history of the volcano.

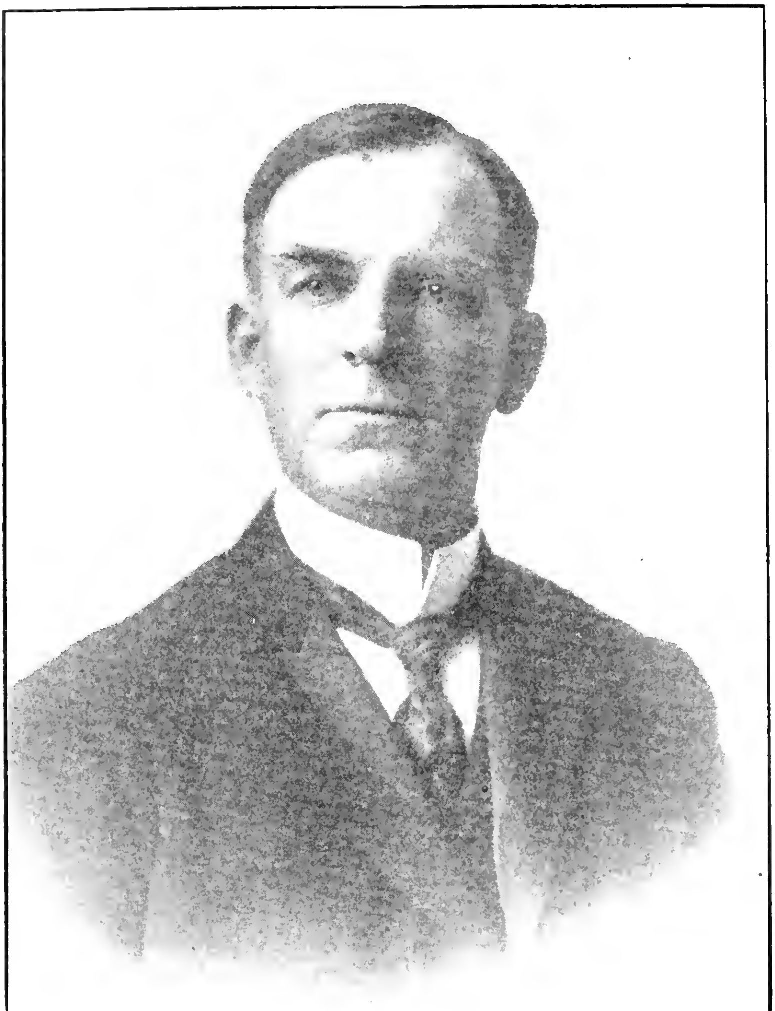
Many of the type examples of volcanic eruptions given in standard college text-books are, however, of the explosive type, in which no molten lava is ejected. The noted eruption of Bandai-San in Japan, on July 15, 1888, is an instance. This old volcanic cone, nearly 180 miles from Yokohama, had been without sign of life for a thousand years of recorded history, yet with only a few minutes of warning consisting of rumblings and moderate earthquake shocks the entire top of the mountain was blown away in some fifteen to twenty explosions lasting less than a half hour. There was no fresh lava or pumice thrown out. Ash and steam were projected upward about 1,000 feet, but the main force of the explosion was nearly horizontal, carrying destruction in a northerly direction for about four miles. The quantity of material blown away has been estimated at one third of a cubic mile.

In the case of Lassen Peak the period of quiescence had probably been greater than a thousand years, judging from the effect of erosion on the old cone. The force of the steam explosions to date has been distributed through six months, yet the height of the ash-laden column has several times reached two miles above the mountains. Had the steam been confined more effectively in Lassen and the force, instead

of being gradually liberated during the six months, been freed during a few minutes, the results would undoubtedly have been comparable to those at Bandai-San. The point, however, is that the difference is qualitative merely and that the nature and magnitude of the eruptions of Lassen Peak fully justify classing them as volcanic.

A study of the tabular summary of the eruptions gives little upon which to base an opinion as to whether the future will bring a fresh lava flow or whether there is being formed a new solfataric basin. The longest period of quiescence was from July 18 to August 10, twenty-three days. The eruptions in November, so far as observations have been made, do not differ materially from those in June. The fact that Soupan Hot Springs, Morgan Hot Springs and those in Hot Springs Valley are situated in valleys at so much lower levels than the new crater, and are apparently unconnected with Lassen, suggests the idea that the recent activity was due to a column of lava working its way upward along the core of the main peak and that this lava may yet issue as a surface flow. It is confessed, however, that the idea is based more on hope than on any scientific data. A visit in July to Bumpass' Hell showed a crater-like depression filled with hot springs, boiling mud pots, and solfataras, yet it is situated on the crest of a high ridge, some two or three thousand feet above Hot Springs Valley and Morgan Hot Springs. The longest diameter of the oval depression is about a quarter of a mile and the height of walls and general appearance are similar to those of the old crater on Lassen Peak. There was no indication that fresh lava flows had ever issued from the crater of Bumpass' Hell; on the contrary, there was strong suggestion that the depression had developed in the old lava by a process the initial stages of which must have strongly resembled the present condition of Lassen Peak.

If the writer were to offer any forecast it would be that the changes going on at the top of Lassen seem likely to form a solfataric basin of the same general character as that of Bumpass' Hell. However, while there is volcanic life there is a possibility of renewed lava flows. Meantime the physiographer has an opportunity of seeing within the United States, at least one phase of volcanic activity and that on a mountain recently occupied by alpine glaciers and standing in a great lava flow studded with minor volcanic cones, many of them almost untouched by erosion—the whole offering a most inviting field for scientific investigation.



DR. W. W. CAMPBELL,

Director of the Lick Observatory, President of the American Association for the Advancement of Science.

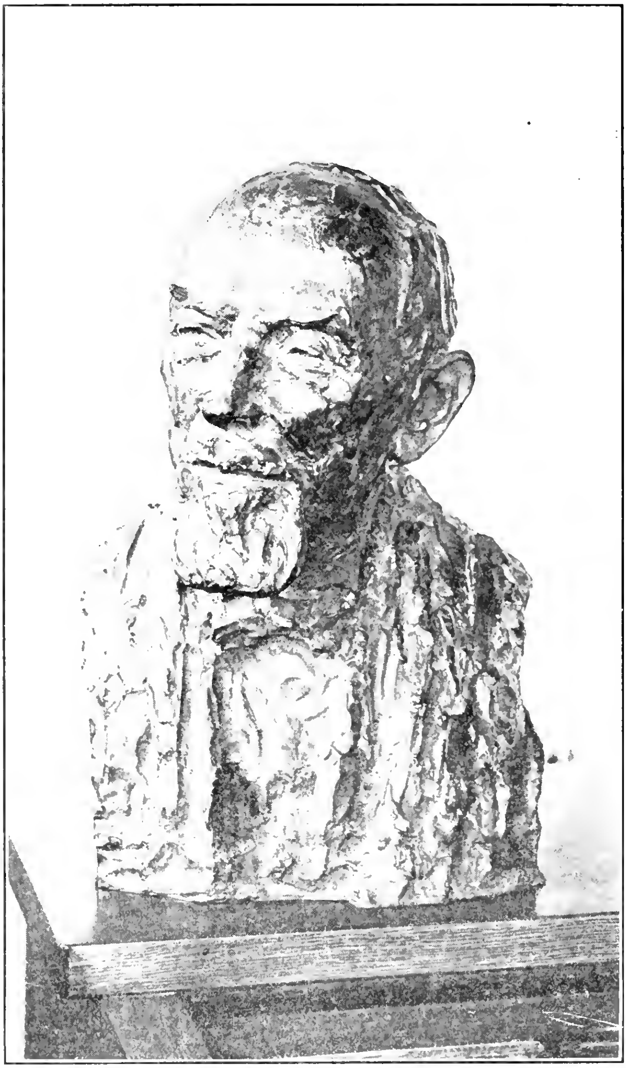
THE PROGRESS OF SCIENCE

SCIENCE ON THE PACIFIC COAST

PROGRESS in science has always been controlled by circumstance. Had Harvey possessed the microscope that a few years after his demonstration of the circulation of the blood Malpighi was applying with distinguished success to the investigation of anatomical problems, he would not have failed to see the capillary network that escaped his unaided eye. And it is a question whether Darwin would have opened the famous notebooks that led after twenty years to the "Origin of Species" had he not been struck by the distribution of animals in South America and the Galapagos Archipelago. The embryology of *Amphioxus* gives obvious support to theories of the formation of the germ layers and of the mesoderm by coelomic pouches that no student of earthworms alone, however diligent, could have constructed. And there is little doubt that Mendel's choice of the garden pea for his investigations on hybridization was a most potent factor in leading him so definitely and speedily to the annunciation of the well-known propositions which have changed the entire course of researches in heredity during the last fifteen years. To the student of physics, the facts of nature assume a quantitative aspect that students of biology are only here and there beginning to recognize. Similarly, the sociologist and the psychologist are now dependent upon biological facts which have lost for the biologist much of their original interest through the development of problems that demand investigation of still more fundamental mechanisms. In the domain of a single science one finds the same connection between experience and ideas. To the investigator of the more generalized types of organisms that respond readily to a wide range of environmental conditions, the laws formulated by investigators of more complex and less plastic organisms seem strangely inadequate; while to the investigator who has discovered them they possess a clarity of outline that affords a welcome substitute for more vaguely expressed, even though more fundamental, conclusions. His eyes filled with the images of secondary adaptations in nature, a behaviorist may formulate his explanations in terms of selection and survival. Whereupon he meets with spirited opposition from the physiologist whose passion it is to reduce vital phenomena to the mechanical terms that have already succeeded in freeing physics and chemistry from the clutch of anthropomorphism.

To understand the Pacific states it is necessary to keep in mind this essential fact, that ideas are dominated by experience. Geologically, geographically, faunistically, socially, economically, the Pacific states form a natural empire distinctly set off from the rest of the country. Mountains and deserts have determined for them a certain isolation that has governed their settlement, the character of their population, whether plant or animal, the development of their institutions, their scientific progress. The region is not only new, but possesses many characteristics that do not ordinarily belong to the experience of citizens of other states.

Some of these recognition marks it is the purpose of this number to consider. The much-vaunted climate of California runs the gamut from typical desert conditions to Alpine, from regions of almost hopeless aridity to regions where humidity becomes an extreme in the other direction. Such diversity is strikingly correlated with floral peculiarities, as one of the papers in this number will show. Under the atmospheric conditions of central and southern California are found the two



DR. EUGENE WOLDEMAR HILGARD.

Professor emeritus of agriculture in the University of California. From a bust presented to the university on the occasion of the dedication of the Agricultural Building.

most important astronomical research institutions in the world. The waters of the Pacific ocean teem with life which forms a rich material background for the investigations of the marine naturalist that can be prosecuted under unusually favorable climatic conditions. This accounts for the presence of a chain of biological laboratories stretching from San Diego to Puget Sound. In the Mohave Desert, fossils have recently been discovered that throw important light upon the evolution of animal forms in the old as well as in the new world. Northern California possesses not only the one active volcano in the limits of the United States but has long harbored the last living representative, for years unknown and neglected, of a tribe of Indians that, in contact for half a century with the frontiers of civilization, continued to live the life of the stone age. It is doubtful whether this remarkable contrast of cultures shows itself anywhere else in our country.

The barriers that have isolated the Pacific coast have more or less successfully shut out tradition. The freedom with which social and political experiments have been made in this region is only paralleled by the experimentation that has drawn the eyes of the world to the pioneer communities of New Zealand and Australia. That freedom to experiment which is the life of science, the necessary companion to discovery, is usually denied in our older communities to social and political pioneers. Whether for good or ill, the citizens of the Pacific states have in numerous cases voted themselves this freedom. The impressive record of the fruits of their boldness will speak in this number for itself.

The Panama Canal will break in upon a certain long remoteness. It will overcome geographical barriers. It will bring new elements to the population that will inevitably produce effects upon social and political institutions. What effects and how? The west is awaiting this new experiment with keen zest and high hopefulness.

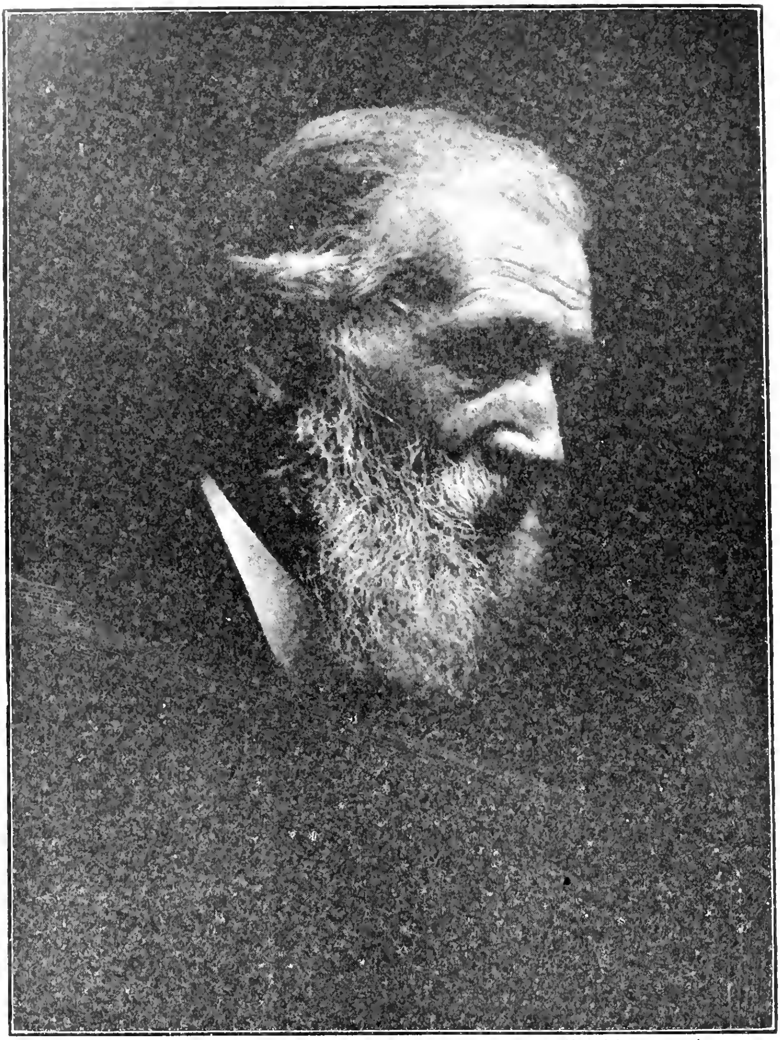
THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Since the Pacific coast of the United States is remote from the centers of population of this country, it has been difficult for members of the American Association living within this area to attend the annual meetings in eastern cities. Meanwhile, members on the Pacific coast have made substantial contributions to the progress of science, and the strength of their interest in organized science has been shown by the federation of sixteen societies organized within this region into the Pacific Association of Scientific Societies about four years ago. Four successful annual meetings of the Pacific Association have been held, one at Stanford University, Palo Alto, California, two at the University of California, Berkeley and the latest meeting in May, 1914, at the University of Washington, Seattle.

In extending the work of the American Association actively on the Pacific coast it was felt that any new organization must cooperate with the work of organizations already on the ground. Plans for the merging of the Pacific Association of Scientific Societies with a Pacific Division of the American Association have accordingly been completed. A constitution drafted for the Pacific Division has been approved by the American Association and ratified by eleven of the constituent societies of the Pacific Association.

The affairs of the Pacific Division have been placed in charge of the Pacific Coast Committee of the American Association of which the chairman is Dr. W. W. Campbell, director of the Lick Observatory, and president of the American Association for 1915. The first meeting of the Pacific Division will be held in 1916, and thereafter annual meetings will occur successively in the cities west of the Rocky Mountains.

The Pacific Division as an organization consists of all members of the American Association residing within



W. E. Dassonville, Photographer.

JOHN MUIR.

The Naturalist of the Pacific Coast, Student of Wilderness, whose recent death is deplored by all those interested in science and letters.

the states of Washington, Oregon, California, Idaho, Utah, Nevada and Arizona; in Mexico, Alaska, the Hawaiian and Philippine Islands. No fee is assessed upon members of the Pacific Division in addition to that paid by regular members elsewhere, and members enjoy all the benefits of relation with the parent body, as well as with the Pacific Division. The various fields of scientific research are represented by affiliations with local scientific societies. Several of these societies are branches of national organizations. Sections of the division may be established in any field not covered by a regularly organized society.

The societies which have already allied themselves with the Pacific Division are: the California Academy of Sciences, the Technical Society of the Pacific Coast, the Seismological Society of America, the Cooper Ornithological Club, the Cordilleran Section of the Geological Society of America, the Pacific Coast Paleontological Society, the Astronomical Society of the Pacific Coast, the Biological Society of the Pacific, the Puget Sound Section of the American Chemical Society, the San Francisco Section of the Archeological Institute of America, and the Pacific Slope Association of Economic Entomologists.

In its scope the Pacific Division purposes to enlist the support of all those within the Pacific region who are interested in scientific matters and to establish affiliations with societies organized in this region for the advancement of scientific work and knowledge.

THE SAN FRANCISCO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE American Association for the Advancement of Science determined at the Cleveland meeting, in January, 1913, to hold a special meeting in San Francisco and vicinity during the year of the Panama-Pacific International Exposition at San Francisco and of the Panama-California Exposition at San Diego. The Pacific Coast Committee of the American Association in charge of this meeting has chosen the week beginning Monday, August 2, as the time for the meeting. The general sessions will be held in San Francisco, while the joint meetings of sections and of societies and the special meetings of societies will be held at the University of California in Berkeley, and on Wednesday, August 4, at Stanford University, near Palo Alto.

This will be the first meeting of the American Association to be held west of the Rocky Mountains. It will, moreover, be in a sense a part of the celebration commemorating the completion of the Panama Canal. Special attention will be given to investigations of world-wide interest for which materials are to be found upon the borders of the Pacific. Many of the scientific problems of the west, though peculiar to the region, are of very general interest in their bearing upon fundamental questions of research. The program for the San Francisco meeting will be composed to a considerable extent of contributions relating to such questions of far-reaching significance. Discussions of other important scientific topics will also be presented.

The opening session of the meeting will be held at the Scottish Rite Auditorium in San Francisco at 10 A.M., Monday, August 2. A general reception will be tendered the visiting members of the association that evening. Four notable addresses are planned for the general evening sessions of the week. Recent developments in oceanographic research will be presented by Dr. Fridtjof Nansen, of Norway. Professor R. A. Daly, of Harvard University, will offer an address upon geologic and biologic problems of the islands of the south Pacific ocean. Professor W. B. Scott, of Princeton University, will discuss the influence of crustal movement in the region of the Panama Canal on the paleontologic relations of North and South America. Dr. Paul S. Reinsch, American ambassador to

China, will present problems concerning the peoples of the Pacific area. Wednesday evening, August 4, is reserved for dinners of scientific societies.

Several important features will mark the section and society meetings of the week. At a joint session on Tuesday, August 2, of the American Mathematical Society, the American Astronomical Society and Section A of the American Association, Professor C. J. Keyser will give an address upon "The Human Significance of Mathematics," and Dr. George E. Hale, of the Mt. Wilson Solar Observatory, Pasadena, California, will speak upon "The Work of a Modern Observatory."

Sessions in physics will be provided for the discussion, among other topics, of spectroscopic investigations of the physics of the air and of high potential electrical experimentation.

The program of the Geological Society of America will include at least three topics—erosion and deposition in arid climates, diastrophism on the Pacific coast and petrological problems of the Pacific area.

Meetings of the Paleontological Society will provide at the first session a series of four addresses upon the general criteria of correlation. In three following sessions symposia will be held for a comparison of the Triassic, Cretaceous and Miocene faunas of the Pacific coast with those of similar periods in other parts of the world.

The program for zoology will include sessions for the discussion of general problems of zoology, embryology and development, problems of conservation, the rôle of variation and heredity in evolution, recent contributions from the field of protozoology, and questions of geographic distribution and of marine biology.

The botanical sessions will be devoted to problems centering upon gymnosperms, which as a group are so widely distributed over the Pacific coast; upon the relation of plants to light; the geographic distribution of plants with especial reference to the origin of the California flora, and upon marine and freshwater algæ.

Sessions for psychology will probably consider problems of animal psychology, the testing of mental traits and the application of psychology to law and medicine.

The anthropological sessions have been planned in conjunction with the American Anthropological Society and the American Folk-Lore Society. The topics of these sessions will be—race in the Pacific area with especial reference to the origin of the American Indians, the history of civilization in the Pacific area with reference especially to relations between Asia and America and the social aspects of race factors in the Pacific area.

Sessions for political and social science are being planned in support of meetings of several societies organized in these fields which will meet during the week immediately following the convocation week of the American Association.

The sessions for education will be devoted to the scientific study of selected educational problems.

Sessions for agriculture will provide for the discussion of problems of animal husbandry, nutrition and food analysis, agronomy and farm management, soil analysis, agricultural chemistry and fertilizers and horticulture.

Among other organizations which will hold special meetings during the convocation week of the American Association are the Archeological Institute of America, the American Phytopathological Society, the American Genetic Society, and an Entomological Congress under the auspices of several entomological societies. Meetings of several societies devoted to economics and social and political science will occur during the week immediately following. The Association of American Agricultural Colleges and Experiment Stations and several other agricultural societies have also appointed meetings for the second week of August. The later part of the month will be occupied with meetings of the International Education Congress and of the National Education Association.

THE POPULAR SCIENCE MONTHLY.

APRIL, 1915

AMERICAN ECONOMIC AND SOCIAL PROBLEMS ARISING OUT OF THE WAR[1]

THE TREND OF AMERICAN VITALITY

BY LOUIS I. DUBLIN, PH.D.

STATISTICIAN, METROPOLITAN LIFE INSURANCE COMPANY, NEW YORK

THE trend of American vitality could best be determined by comparing a series of life tables for the last three or four decades. These would tell us whether the expectation of life at each age had increased or decreased during this period; but, unfortunately, no such tables are at hand. We are only now beginning to realize the value of such statistical devices for measuring our vital resources. The Federal Bureau of the Census is for the first time engaged in preparing comprehensive life tables. These will, we hope, give us fundamental data on American life expectancy in the registration area. For the country as a whole, nothing worthy of consideration will be available until our vital statistics have been much improved and the registration area extended to include all the states.

Our analysis will, therefore, be at best inadequate and incomplete. We have, in the first place, a few life tables for some cities and states which tend to show the trend of vitality in these places. The New York City tables for the period 1909 to 1911, for example, indicate that the probable span of life for children under five has been extended by about ten years since the earlier tables for the period 1879 to 1881 were prepared. The improvement in life expectancy continues until about age 35. From this age onward the expectation becomes reduced. In Massachusetts, the reduction in the expectation of life has occurred at an even earlier age. Life tables for a few other states show similar

[1] A series of papers presented before the Section for Social and Economic Science of the American Association for the Advancement of Science at a meeting in Philadelphia on December 29, 1914, arranged by the Secretary of the Section, Seymour C. Loomis.

conditions, the only variation being in the age at which the change sets in. In spite of the unsatisfactory data from which most of these tables were derived, we may infer that the expectation of life at the higher ages has been lessened over a wide area of the country during the last three decades.

This conclusion is confirmed in a measure by a survey of the mortality rates at the several age periods of adult life in the registration states for the years 1900 and 1911, respectively. In order to make our comparison valid, we have been careful to consider only the states which comprised the registration area in 1900. You will note (Table I.) that all age groups up to and including 35 to 44 for males, and 45 to 54 for females show decreases in the rates for 1911 as against those for 1900. From this age period onward, however, the rates for 1911 are higher than for the earlier date. It is evident that at all ages the mortality is much more favorable for females than for males; but in both sexes the forces that have been at work to reduce mortality in early life have not continued in effectiveness. After the period of middle life, an apparent deterioration has occurred.

What then are the factors in this change? From the records of the Bureau of the Census for the registration area it would appear that the causes of death which predominate at the advanced ages, namely, cancer, diabetes, apoplexy, organic heart disease, diseases of the arteries, cirrhosis of the liver and Bright's disease have increased in their incidence during the last ten years. This is shown in the accompanying Table II. It is significant that, together, these seven causes account for more than one half of the deaths after the age of forty.

Table I

Comparison of Mortality of Males and Females by Age Groups. Death-Rates per 1,000 Population

(Registration States as constituted in 1900)

	Males			Females		
Age	1900	1911	Per Cent. Increase or Decrease	1900	1911	Per Cent. Increase or Decrease
Under 5	54.2	39.8	−26.57	45.8	33.3	−27.29
5– 9	4.7	3.4	−27.66	4.6	3.1	−32.61
10–14	2.9	2.4	−17.24	3.1	2.1	−32.26
15–19	4.9	3.7	−24.49	4.8	3.3	−31.25
20–24	7.0	5.3	−24.29	6.7	4.7	−29.85
25–34	8.3	6.7	−19.28	8.2	6.0	−26.83
35–44	10.8	10.4	− 3.70	9.8	8.3	−15.31
45–54	15.8	16.1	+ 1.90	14.2	12.9	− 9.15
55–64	28.9	30.9	+ 6.92	25.8	26.0	+ 0.78
65–74	59.6	61.6	+ 3.36	53.8	55.1	+ 2.42
75 and over	146.1	147.4	+ 0.89	139.5	139.2	− 0.22
All ages	17.6	15.8	−10.23	16.5	14.0	−15.15

TABLE II

DEATH-RATE PER 100,000 OF POPULATION FOR CERTAIN CAUSES OF DEATH
MALE AND FEMALE COMBINED

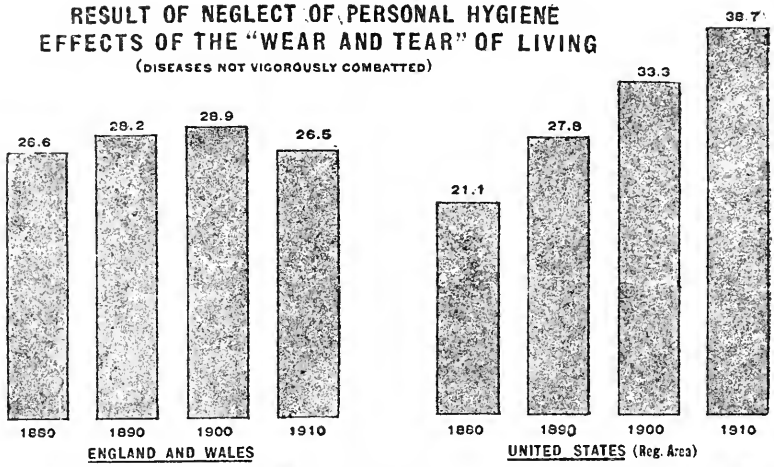
(Registration States as constituted in 1900)

Cause of Death	1900	1910	Per Cent. Increase
1. Cancer (all forms)	63.5	82.9	30.6
2. Diabetes	11.0	17.6	60.0
3. Cerebral hemorrhage and apoplexy	72.5	86.1	18.8
4. Organic diseases of the heart	116.0	161.6	39.3
5. Diseases of arteries	5.2	25.8	396.2
6. Cirrhosis of liver	12.6	14.4	14.3
7. Bright's disease	81.0	95.7	18.1
Total	361.8	484.1	33.8

It has, therefore, been assumed quite generally that the deterioration observed after age 40 is due to the increase in the incidence of these so-called "degenerative" diseases. Indeed, much of the propaganda for better personal hygiene at middle life has received its impetus from the discussion of this tendency in American mortality. We must not forget, however, that our returns for causes of death are still far too inaccurate to warrant complete confidence. Only a small proportion of our statements of cause are confirmed by autopsy. Yet, the changes that have occurred in our medical practise with reference to statements of cause of death have not been of such radical character during the last ten years as to invalidate the conclusions drawn. The figures are apparently confirmed by independent analyses made in a number of specialized areas in which it appears that these degenerative diseases have increased at about the same rate as in the registration states. We are warranted in concluding, therefore, in spite of the lack of absolutely accurate data, that the trend of our mortality in middle life is at present unfavorable and that this condition is accompanied by an increasing incidence of the degenerative diseases.

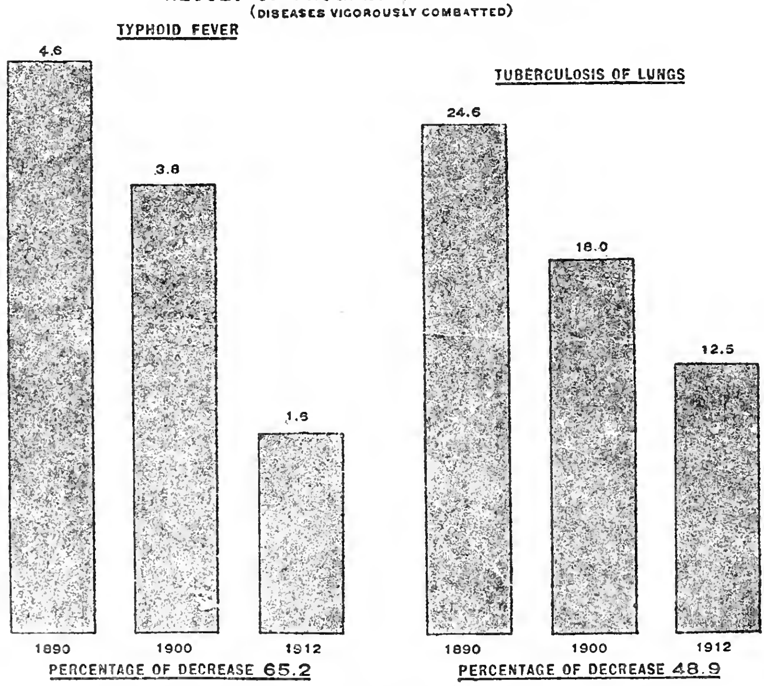
The question we now desire to put squarely is this: What are the forces at work in American life which have made for this increased mortality at the adult ages? In a recent paper entitled "The Possibilities of Reducing Mortality at the Higher Age Groups" the writer pointed out some of the conditions of present-day life which he believed tended to increase the death rates from the so-called "degenerative" diseases. In this paper reference was made to the greater use of alcoholic beverages and especially to the deleterious effects of modern conditions of industry. It was assumed that the changing conditions of American industrial life involved a greater strain on the organism, causing it to break down at an earlier age than was formerly the case under the less intense conditions of labor. In the present paper I wish to refer to another element which is apparently at work in the causation of these higher death rates from the diseases above mentioned.

RESULT OF NEGLECT OF PERSONAL HYGIENE
EFFECTS OF THE "WEAR AND TEAR" OF LIVING
(DISEASES NOT VIGOROUSLY COMBATTED)



DEGENERATIVE DISEASES—COMBINED DEATH RATE—PER 10,000 POPULATION—FROM DISEASES OF HEART, BLOOD VESSELS AND KIDNEYS.

RESULT OF PROGRESS. PUBLIC HYGIENE
(DISEASES VIGOROUSLY COMBATTED)



DEATH RATE PER 10,000 OF POPULATION IN THE U. S. REG. AREA.
TYPHOID FEVER AND TUBERCULOSIS OF LUNGS.

I refer to important changes in the composition and characteristics of the population. The last thirty years have seen a great influx of foreign peoples to this country. The reports of the Department of Labor show that in the period since 1880, 22,300,000 immigrants reached our shores. In the year ending June 30, 1914, the net increase in population due to immigration was 915,000. These immigrants have settled principally in the registration states. In a recent paper, Professor Chapin, of Smith College, has pointed out that the nine states, California, Connecticut, Illinois, Massachusetts, Michigan, New Jersey, New York, Ohio, and Pennsylvania have been receiving over three fourths of the total immigration during the last 25 years.[2] This tendency to concentration of immigration in a few of our eastern states has been so marked that it has been assumed that from 65 to 70 per cent. of the urban growth of the United States is due to immigration. Recent immigration has given a distinctive tone to our urban life.

This immigration to our registration area must, therefore, largely determine the adult mortality which these communities experience. If the immigrants are relatively short lived and suffer especially from the diseases of middle life, then we must expect an increased incidence in the mortality rates from these causes in the area where they congregate, and correspondingly a reduction in the expectation of life in the total population.

While immigrants to America come from all parts of the world, the larger number have come, in recent years, from the countries of southern and eastern Europe. Thus, in the year closing June 30, 1914, 23.3 per cent. of all immigrants came from Italy; 21.0 per cent. from Russia and Finland; 11.1 per cent. from Austria; 11.8 per cent. from Hungary. Together, these four countries supplied America with 67.1 per cent. of its total immigration in this year. The mortality rates prevailing normally in these countries are uniformly higher than those found in the registration area. Thus, according to the latest available figures the crude death rate in Russia was 28.9 per 1,000 in 1909; 18.2 per 1,000 in Italy in 1912; 20.5 per 1,000 in Austria, and 23.3 per 1,000 in Hungary in 1912. We have no right to assume that the mere entry of these foreign peoples has at once a favorable effect upon their mortality. Their adverse conditions of life, especially in our large cities, the economic stress to which they are put, and the dangers in the unskilled trades in which they engage, all would point to a continuance, at least, of the higher death rates from which they suffer in their native countries.

Such a conclusion is certainly warranted by the mortality statistics

[2] "Immigration as a Source of Urban Increase," by F. Stuart Chapin, Ph.D., Qtly. Publications of the American Statistical Ass'n, Vol. XIV., Sept., 1914.

for the state of New York.[3] In 1910, at the age period 45 to 49, the death rate among native-born white males was 16.6 per 1,000, whereas the rate for the same age period among foreign-born white males was 17.7 per 1,000, or an excess of 6.6 per cent. for the foreign-born. For the age periods 55 to 59, the two rates are 27.0 and 35.4, respectively, showing an excess of 13.2 per cent. in the mortality of the foreign-born white males over the native-born. This excess is marked throughout all the advanced age periods. The advantage in favor of native-born females over foreign-born females is equally striking and begins at an even earlier age period in middle life. Conditions similar to the above have been noted in the vital statistics for the registration area of the United States. This would indicate that the foreign-born whites as well as the native-born of foreign parentage show, at all higher age periods, and for both sexes, a mortality largely in excess of that of the native-born of native parentage.

The statistics of the degenerative diseases indicate, furthermore, that the nativity factor plays an important part in determining the death rates from these diseases. Thus, both in the registration states and cities where this subject has been studied, it has been found that the native-born of native parentage show almost uniformly a lower incidence from Bright's disease, diabetes and cirrhosis of the liver than do the foreign-born and their children. The rates, to be sure, vary considerably with the different nationalities; but taken as a group, the foreign-born apparently show a lower resistance to the degenerative processes which these diseases imply. Is it to be wondered at, therefore, that the death rates for large cities and states in the registration area show increases in mortality at the higher age groups? In view of the marked changes that have occurred in the composition and characteristics of our population, it would indeed be surprising if these changes in mortality had not occurred.

It is not the intention of this paper to touch upon immigration as one of our national problems except to state what we should know with regard to our mortality rates; namely, that our large centers of population are showing unfavorable mortality tendencies after middle life and that in all probability these tendencies are dependent upon the character of our immigration.

This conclusion does not in any way make unnecessary the caution and advice which the associates of the Life Extension Institute and other hygienists have taught us. It has already been demonstrated that much can be accomplished by emphasizing the necessity for more careful personal hygiene. This will affect not only our own native stock, but also the foreign race stocks in our population. Indeed, if a full return is to be received from our campaigns for life extension, it is necessary that an attempt be made to instruct the foreign population in the principles of

[3] Thirty-third Annual Report, New York State Dept. of Health, pp. 254–55.

personal and civic hygiene. This will involve very difficult problems of education, but the results will prove as fruitful as those which have been directed toward our better circumstanced classes. The problem of the mortality at the higher age groups is a complex one and many things will need to be done if we hope to accomplish our chief aim, which should be to show a saving in life all along the line, both in our native and foreign-born stocks, not only at the younger ages where American medicine has made brilliant contributions, but more especially after middle life.

COMMUNITY DEFENSE OF NATIONAL VITALITY

By C.-E. A. WINSLOW

DIRECTOR, DIVISION OF PUBLICITY AND EDUCATION, N. Y. STATE DEPARTMENT OF HEALTH

THE shadow of the tragedy in Europe can not wholly be lifted from our thoughts during the meetings of this Convocation Week. As the representatives of science and of the applications of science to the better ordering of the life of man, this barbarism shocks and amazes, as much as it saddens us. As scientific men, however, we are accustomed to recognize that slight constant factors may be as significant in their effects as large and occasional ones. It is well, as we take counsel at this time, to remember that peace, which has her victories as well as war, has also her defeats, and her ranks on ranks of killed and wounded.

It is tragic that a million or so of men should have perished in battle during the last six months of 1914, and that many more should have been wounded. It is also tragic that a million and a half men, women and children should have died in 1914 in the United States, and that some three million people should be on the sick list all the time. The most fearful thing about the war is that it seems to us at this distance so wantonly needless. Yet we are told on the good authority of Professor Irving Fisher that over forty per cent. of our annual toll of civil death and suffering is needless also.

These facts and this comparison are trite and familiar. Yet as a public health official, seeing close at hand the problems of preventable disease and the meager efforts made to solve them, I often wonder whether you and I really believe these things, and, if we do, why we do not act upon our knowledge. Is it merely a rhetorical phrase that 600,000 people die needlessly in our midst—or is it really true?

Let me rehearse very briefly the disasters inflicted upon our country during the past year, by foes whom we may conquer if we seriously will to do so. First of all, a quarter of a million infants were carried off before they had rounded out the first year of life. Try to get this out of the realm of statistics and visualize it as a solid fact. Think of

what the suffering of a little baby's death means, and realize that the tragedy has come to more than one in ten of all the households gladdened by birth during the year. Yet nothing is more certain than that nearly half of these infant deaths are preventable, and by simple and definite procedures. The establishment of infant welfare stations for the instruction of mothers in breast feeding and the other essentials of maternal care is a measure that never fails to bring results. In New York City the infant death rate has been reduced one third by this means in a period of seven years, and a state-wide campaign along similar lines inaugurated last summer by the New York State Department of Health resulted during the first four months in a saving of 700 infant lives.

Many of us, I suppose, have felt that there must have been a strange lack, either of responsibility or of humanity, or of imagination, in the chancelleries of Europe when the bronze doors of Janus were unlocked. Is there not the same lack nearer home while this slaughter of the innocents goes on unchecked?

The children who escape the perils of infancy are next exposed to the attack of such communicable diseases as diphtheria, scarlet fever, measles and whooping cough. These enemies are less easy to control, but they may be held in check by measures for prompt diagnosis and intelligent isolation, and by the cultivation of habits of personal cleanliness. Against diphtheria, in particular, we have a practically certain defense in antitoxin, yet we lose 20,000 children every year from this disease because some of our trusted guardians, the physicians, neglect or postpone the use of this simple and specific weapon.

When the army of civil life is actually mustered in for active service, the enemies, typhoid fever and tuberculosis, make their great frontal attacks. Typhoid fever has been reduced to an almost negligible quantity in many communities, and those which lag behind pay their own penalty for special and conspicuous neglect. Against tuberculosis, on the other hand, we are all over the country doing little more than fight a drawn battle. The great wave of enthusiasm which swept over the United States ten years ago has not yet achieved all the results anticipated. There are still 150,000 deaths a year from this disease, of which three fourths should be prevented. The theory of the anti-tuberculosis campaign has been well thought out, but in few places has the practical machinery for carrying it out been adequately supplied in the shape of hospitals for the isolation of advanced, and the cure of early cases, and of visiting nurses to secure the proper care of patients in the home. Yet it is of little value to preach hygienic living without providing the means for practicing what we teach. Nowhere has the enemy been vigorously pursued into the insanitary tenements, and the dusty, unventilated factories where he gains his first foothold. The work of our tenement departments and state labor bureau is only a

beginning of what must be done if we are to check the insidious influences which prepare the ground for the tubercle germ.

Finally, the veterans of our army, who have resisted all earlier attacks, are exposed to their own peculiar dangers. Diseases of the heart and arteries, Bright's disease, and cancer together carry off 300,000 men and women every year, and we are face to face with the sinister fact that while at every other point of the battle line we are at least holding our own, these diseases of later life appear to be actually on the increase. Yet in any individual case, we know that the appropriate advice as to the hygienic conduct of a defective bodily mechanism would prolong life, often by many years.

If we really want to prevent preventable diseases, we must supply the machinery, the fortifications and munitions of war to use against the enemy. We must install effective water purification plants and adequate systems of sewerage and sewage disposal. We must provide infant welfare stations in the proportion of one for every 20,000 of the population, if the death rate of infants is to be effectively reduced. We must have adequate systems of medical school inspection and school nurses, not one for each 2,500 school children, but one for every 1,000, if our young soldiers of peace are to come to maturity in full vigor and free from physical defects. We must build contagious-disease hospitals, with a capacity of one bed for every 2,000 of the population. We must provide tuberculosis hospitals with a capacity of one bed for every 1,000 of the population for the cure of early and the isolation of advanced cases of this disease, and corps of visiting nurses to find incipient cases and secure proper care for patients in the home.

It is the health officer who must ultimately furnish expert guidance and leadership for the public health campaign. One of the most unfortunate aspects of the present situation is that too often the public distrusts its natural sanitary leaders, and sometimes the health officer is so blind to his opportunities that other agencies must perforce step into the breach. The most substantial progress can only be made, however, when constructive initiative and legal authority are conjoined. It is essential that the task of officering the army of the public health should be entrusted only to trained and experienced experts, qualified by knowledge and disposition for their work. Having obtained such men, the local and state departments of health must be given adequate powers and liberal appropriations. Fifty cents per capita should be a minimum for the city, and twenty cents per capita for the state, if the organization of the general health campaign is to be efficiently maintained.

All this will cost money—perhaps five or ten times what we are to-day devoting to our national defense against diseases. The United States spends each year three hundred millions of dollars for protection

against human enemies who will probably never come. Surely we can spare one half of this sum for foes who will surely and inevitably kill a million and a half of our people this very year, if we do not stop the slaughter.

Material equipment and the provision of a standing army of experts is, however, only a part of the necessary preparation for the war against disease. The reserves are always at the front in its battles, and the warfare is a guerilla warfare in which each one must do his part. Education is the key-note of the modern campaign for public health. Tuberculosis and infant mortality are preeminent among all the causes of preventable disease and death as the greatest scourges, from the abatement of which the largest results for humanity are to be attained. In each case the fight must be won, not merely by the construction of public works, but by the conduct of the individual life. The same thing is true with regard to the spread of the acute contagia, the burden of venereal disease, the obscure ill effects of defective eyes and ears and teeth, and a dozen other problems which in greater or less degree concern the public health. In every one of these cases the results we are striving for can only be reached by spreading a clear knowledge of the ways in which disease spreads, and the ways in which it is prevented, among the mothers who bring up babies and the men who pay rent in the tenement and work in the stores and factories.

As an illustration of what may be done along this line of public education I may cite the efforts being made by the New York State Department of Health to bring about a more effective contact between the expert who has the knowledge and the individual citizen who must make use of it.

The monthly bulletin of the department is our official organ of communication with the public, and this bulletin we have first of all attempted to popularize and to convert into an effective medium of education. We have changed its name to *Health News*. We have banished from its columns all long and technical discussions (which when necessary are issued as Special Bulletins to a selected mailing list). We have attempted to print in each number half a dozen brief articles on timely health topics by men of national reputation in their respective fields. We have paid special attention to real news items in regard to current sanitary problems and sanitary progress in the state. Each number is illustrated with cartoons, diagrams and photographs. The edition has been enlarged to over 30,000 copies, and it is mailed during the winter months to each of the 15,000 school principals in the state. We look forward in the future to a day when biology and public health shall occupy not a subordinate, but a central position in the school curriculum.

In order to come in touch with a wider public than we can hope to

reach with our own publications, we have asked the newspapers of the state to cooperate with us, and have met with generous response. We send out each week a 500-word health hint on such topics as Infant Feeding, Hot Weather Hygiene, Health on the Farm, County Hospitals and Taxes, Cancer a Preventable Disease, and the like. The "Hints" are mailed in proof or in electrotype, as desired, and over 400 daily and weekly papers are using them each week throughout the state. We estimate that by this means we are reaching a million and a half of readers.

The printed page must be supplemented by a more striking and vivid appeal to the eye, and the popular exhibit should form a part of any well-organized public health campaign. The work of the New York State Department during the summer was centered particularly upon the prevention of infant mortality, and to aid in this campaign we prepared three child-welfare exhibits, which between April and July were shown in twenty-five counties of the state. These exhibits led in many cases to the establishment of infant welfare stations and in every community through which the exhibits passed there has been left a trail of enthusiastic and constructive infant-welfare work. During the fall, these infant-welfare exhibits and others dealing with rural hygiene have been shown at forty county fairs throughout the state. The Department arranges for lectures upon health topics whenever requested, and the members of the staff as well as the sanitary supervisors are kept busy filling engagements of this kind. Three special lecturers on diseases of the eye and ear, on mouth hygiene and the care of the teeth, and on social hygiene are attached to the department and we plan during the coming winter to prepare and print a series of syllabi of lectures on all the more important public health topics, with a set of lantern slides corresponding to each lecture which may be sent out on request for the use of health officers and other local lectures. Original moving-picture films dealing with infant-welfare work and rural hygiene are now being prepared for use.

I have dwelt somewhat in detail upon the public education work of the New York State Department of Health merely as a type of what many progressive state departments, like Virginia and North Carolina, and city departments, like Chicago, are carrying forward. The work of the Life Extension Institute is full of promise of a more direct and personal type of education under private auspices, and the Metropolitan Life Insurance Company is doing a splendid work in diffusing the principles of public health, not only among its own policyholders, but in the community at large.

One of the next tasks of the future, as it seems to me, is to add to the training of the public in the elements of hygiene and sanitation some plan of organization which shall make our health militia effective

for all forms of necessary common action. We have in New York state, a corps of district sanitary supervisors, who form a link between the State Department of Health and the local health officer, bringing to the latter the expert knowledge and the moral support of the whole state. We have a State Sanitary Officers' Association, which is now being organized in county branches. Beyond the health officers, we want the leaders of the public to be informed as to local health needs and ready to move effectively to meet them. If each city and town and rural county had a group of public-spirited citizens organized to seek out and solve the more pressing problems of their particular locality, and to support the local and state authorities in the general conduct of the public health campaign, progress could be made by leaps and bounds. To-day we find in many a city an anti-tuberculosis association, a milk committee, a visiting nurse association, an associated charities and various churches' and merchants' associations and other bodies dealing with phases of health work, often working at cross purposes with each other and with the local health department. These forces should be knit together in local health associations like the revolutionary committees of correspondence for community defense against disease. They should be kept in communication with each other and with the most recent current advances in sanitary theory and practise, perhaps by developing them as local branches of the American Public Health Association. Plans are now under way in New York State for the organization of such militia companies. We have thought of many titles, Health Association, Health League, Life Extension League, Life Lengthening League, without finding quite the right one; but the thing itself we are sure we need.

Is it not time that a serious effort was made along some such lines as those I have outlined, to mobilize our people for the public health? The nation that first really accomplishes this task will be so strong, and at the same time so sensitive of the sacredness of human life, that neither the fear of others nor its own aggression will be likely to compel it to mobilize for any less noble cause.

SOME RESULTS OF PERIODIC HEALTH EXAMINATIONS

By EUGENE L. FISK, M.D.

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OF the terrible engines of destruction that science, the handmaiden of war as well as of peace, has brought to the firing line in this present world conflict, there is none more terrible for offense, more potent for defense, than that war engine supplied by nature—man.

Even the prevision of military experts was at fault as to the line along which modern warfare would be waged. When it was reported

from Balkan battle fields that desperate bayonet charges figured in the strife, many were incredulous and ascribed such reports to the violent imagination of newspaper correspondents remote from the field.

But there is abundant evidence that a country at war must, in the final test, rely for success upon the marching, shooting, bayonet-thrusting, trench-digging, misery-enduring qualities of the common soldier, of that primitive war engine that dates from the cave-dweller and beyond.

Some eminent and patriotic gentlemen have lately formed a National Security League, for the purpose of testing the preparedness of this country for war—preparedness, according to them, connoting armaments, ships guns, ammunition and a trained citizen soldiery. The physical sufficiency of our citizens for war seems to be taken for granted—all they need is training. In fact, as a feature of preparedness, it has been suggested that the physical standard for the acceptance of recruits be lowered.

But when the test of battle comes, when the vital organs of the bodies of our soldiers are put under a tremendous strain, what then? Preparedness will then mean something in addition to guns and ammunition and men. Just as a gun will be of little use unless of modern make and firing capacity, so will a soldier be of little use unless he is a sound, efficient and enduring man.

It is evident, therefore, that the present state of Amerian vitality, as well as its general trend, is a proper subject for a consideration in any investigation of the preparedness of this country for military defense. Fortunately, this physical preparedness for war is the best kind of preparedness for peace, for industrial progress, for a forward and upward-moving civilization.

The Present State and Trend of American Vitality

In attempting to measure American vitality, I believe we should fix as a standard organic soundness and at least functional normality, and then endeavor to ascertain how far below such a standard of optimum condition the citizens of this country are registering. We should also endeavor to ascertain whether the movement is toward the optimum or away from it.

To ascertain the trend of American vitality, we are largely dependent upon the census and registration mortality statistics. These, unsatisfactory as they are, in regard to scientific accuracy, nevertheless strongly support the view that the movement of vitality is not toward the optimum, notwithstanding the steady fall in the general death rate. The diseases due to the germs, the communicable diseases, which chiefly affect young lives, are being rapidly eliminated, but the diseases due to faulty living habits, characterized by the wearing out or the giving out

of the vital machinery, are heavily on the increase in this country. There is no evidence, however, that these diseases are on the increase in Great Britain. Nor is there in Great Britain, as in this country, any evidence of a rising mortality among those in middle life and later who are chiefly affected by these degenerative maladies. The same may be said of Germany, where the death rate at every age period has steadily fallen during the past thirty years, notwithstanding a tremendous industrial progress.

This masking of the encroachment of the degenerative and regressive class of diseases by the fall in the death rate from the communicable diseases is a source of danger, in that it begets a feeling of false confidence and inhibits much-needed activity for the real up-building of a resistant race rather than mere protection of the non-resistant from one class of maladies.

The present state of American vitality and physical efficiency as compared to the best attainable state can only be accurately measured by thorough physical examination of all citizens. The examination of all citizens is at present not practicable, but much can be learned from the results already attained in the examination of representative groups. The figures that I present in this paper are derived from two classes of individuals examined by the Life Extension Institute.

First: Insurance policyholders, to whom the privilege of free medical examination at certain intervals has been extended by the life insurance companies having contracts with the Institute to perform this service.

Second: Employees of commercial houses, banks, trust companies, etc., to whom this privilege has been extended by their employers who contracted with the Institute for this service.

Results of the Examination of Life Insurance Policyholders by the Life Extension Institute

	Per Cent.
Normal	2.40
Imperfect—Advice needed regarding physical condition or living habits	97.60
Not aware of impairment	93.04
Referred to physician for treatment	65.75

Classification of Impairments

Moderate to Serious

	Per Cent.
Organic heart disease	4.50
Arteriosclerosis—thickened arteries	6.27
High or low blood-pressure	23.50
Urinary—albumin, sugar, casts	53.60
Individuals showing combined disturbance of circulation and kidneys	15.83
Nervous	.92

Lungs—possible tuberculosis	1.40
Venereal	.77

Minor to Moderate

	Per Cent.
Functional circulatory—rapid, slow or intermittent pulse	7.17
Urinary	25.05
Digestive organs	12.32
Constipation	27.53
Nose and throat	15.92
Ears	10.30
Decayed teeth and infected gums	11.76
Anemia	2.69
Skin	3.42
Errors in diet (pronounced)	30.85
Errors in personal hygiene	68.04

Physical Defects

	Per Cent.
Faulty vision—uncorrected	5.51
Flat foot	4.11
Faulty posture	9.58
Rupture—no truss	1.12
Overweight—important	12.23
Underweight—important	9.13
Unclassified	12.30

The above statement shows the percentages that the various impairments are of the whole number of individuals examined. Many policyholders showed several combined impairments. Average age 35.

RESULTS OF THE EXAMINATION OF EMPLOYEES OF COMMERCIAL HOUSES, BANKS, ETC., BY THE LIFE EXTENSION INSTITUTE

	Per Cent.
Normal	3.14
Imperfect—advice needed regarding physical condition or living habits	96.86
Not aware of impairment	96.69
Referred to physicians for treatment	59.00

Classification of Impairments

Moderate to Serious

	Per Cent.
Organic heart disease	5.38
Arteriosclerosis—thickened arteries	13.10
High or low blood-pressure	25.81
Urinary—albumin, sugar, casts	35.63
Individuals showing combined disturbance of circulation and kidneys	12.77
Nervous	.73
Lungs—possible tuberculosis	.99
Venereal	.46

Minor to Moderate

	Per Cent.
Functional circulatory—rapid, slow or intermittent pulse	11.37
Urinary (high and low specific gravity, crystals, indican, etc.)	21.62
Digestive organs	6.12
Constipation	14.70
Nose and throat	34.53
Ears	16.96
Decayed teeth and infected gums	22.22
Anemia	2.72
Skin	6.38
Errors in diet (pronounced)	13.70
Errors in personal hygiene	31.60

Physical Defects

	Per Cent.
Faulty vision, uncorrected	16.03
Flat foot	3.19
Faulty posture	7.38
Rupture—no truss	1.79
Overweight—important	5.45
Underweight—important	19.16
Unclassified	7.38

The above statement shows the percentages that the various impairments are of the whole number of employees examined. Many employees, of course, show several combined impairments. Average age 30.

The first group is composed of individuals who apply voluntarily for this service. It has been assumed that many of these people had at least a subconsciousness of impairment. Nevertheless, 93 per cent. of those found impaired were, according to their statements, unaware of any impairment.

Although the second group were not compulsorily examined, a practically unanimous consent to the examination removed any element of self-selection, and the group may be regarded as fairly representative of the average condition obtaining among the employees of such business institutions in large cities.

In studying these figures, it should be borne in mind that the particular purpose back of this system of examining is to secure a complete picture of the individual, and thus all impairments or imperfections found have been carefully recorded without regard to the present state of knowledge as to their significance. Examination for life insurance, for tuberculosis, for eligibility for employment, for ascertaining the influence of particular occupations or hazards, etc., and other physical examination for special purposes might produce a different record. In the institute's work, however, information is sought for the sole purpose of assisting the individual to raise himself to a higher standard of health and efficiency; hence, any departure from the normal is re-

corded, and particular attention is given to harmful living habits carrying potential impairment.

The noteworthy features of the record are as follows:

1. The high percentage of impairments or imperfections.
2. The high percentage of disturbances or impairments of the heart, blood vessels and kidneys.
3. The large percentage of individuals in both groups who were not aware of impairment—93 per cent. among insurance policyholders and 96 per cent. among commercial groups.

Among the insurance policyholders 65 per cent., and among the commercial groups 59 per cent., were sufficiently impaired to be referred to physicians for treatment with full report of the conditions found. In appropriate cases instruction in personal hygiene was also given.

Those in the commercial group were examined by trained examiners of the home-office staff, all of whom followed uniform methods and standards. All laboratory work was done at the home office, thus eliminating possible errors from differing standards of examination or technique. Those in the life-insurance group were scattered throughout the country, but were examined by physicians specially selected and instructed regarding the standards and methods to be observed.

Probably the most striking and important fact revealed by these examinations is the large percentage of young men showing arteriosclerosis, or thickening arteries. This condition is one of slow growth, and it is not, after all, surprising, in view of the high and increasing death rate from cardiovascular troubles in middle life, that we should find the beginnings of these chronic changes in early life.

The lesson from these figures is that we must often start in at 25 or earlier to prevent a death from apoplexy at 45.

The checking of the degenerative maladies is not such a spectacular matter as the stamping out of typhoid, yellow fever or tuberculosis, but the possibilities for effective work through personal hygiene and guidance in correct living habits are quite as great. All along the line we find magnificent opportunities for improvement, teeth, eyes, nose, throat, ears, circulation, living habits, etc.

Those who accept the average man as a fairly able-bodied citizen seldom realize how far below his attainable condition of physical soundness and efficiency he is.

To some, this may seem like a study in pessimism. It may smack of pathological detective work which seeks to uncover human frailties and conjure up a Cassandra-like vision of "Woe, woe, to the human race." This is a superficial and pitifully inadequate view of activities fraught with tremendous possibilities for racial advancement.

What about the harmful effect of mental suggestion? For some

years we have had a surfeit of "mental suggestion." Everything from stone-in-the-kidney to bow-legs has been ascribed to mental suggestion, or to something buried in the psyche, and there has been a tendency to encourage a timidity regarding even the thought of disease. This does not make for a brave and virile race. Men who consider themselves physically brave will shiver at the thought of tuberculosis, cancer, or heart disease. It is well to defend ourselves from disease, but not well to fear it. Just as it is well to prepare against a foreign enemy while not fearing to meet him eye to eye. Unfortunately, a considerable proportion of our population is constitutionally pusillanimous with regard to disease. Such people must be safeguarded from undue worry, but we should endeavor to train them to a more courageous attitude towards life and its disease perils. To avoid looking for impairment lest we find it, and at the same time find an opportunity to check the sapping of our physical foundations, is certainly a naïve philosophy. Will the "scare" be less when the actual breakdown occurs? It will then be a scare without hope as against a scare with hope.

The mind should not be constantly focused upon physical condition, but common-sense measures taken for the correction of the impairments, and then renewed courage and confidence should accompany the knowledge that there is no obscure or unknown or neglected condition at work undermining vitality.

In conclusion, I would urge that physical examinations be conducted along standard lines, as far as possible, in order that the data may be assembled in homogeneous form whenever possible. A complete survey of the body should be made, in order that any abnormality of any region may be recorded for future study, as well as for immediate use in benefiting the individual.

In carrying out the theory that this is a study in optimism, and not in pessimism, permit me to suggest to those who have been well satisfied with existing conditions that there is ground for felicitation in the fact that so many people are below par. If a farmer finds that his ground, good as he thought it was, is capable of producing double the quantity of corn and potatoes, must he then repine and become a pessimist?

I think we should view the matter in this way: Good as we may think we have reason for felicitating ourselves on being, it is a joyful thought that there is so much room for improvement. Strong and self-reliant as we are, as a nation, let us rejoice that what we are does not constitute the pinnacle of strength, and that future development may give us reason for even greater confidence in our power to endure and to prevail.

THE RACIAL ELEMENT IN NATIONAL VITALITY

By Dr. CHAS. B. DAVENPORT
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OUR population is made up of such a variety of racial elements that it is hardly possible to make any statement about it as a whole that is both true and significant. Especially is this so in the field of statistics. When we say the death rate in the United States is 15.0 for the registration area, the number may be very accurate; but is it very significant? It throws together data of partly black states and those of nearly pure white: those of the slums of great cities with masses of recent immigrants and those of Kentucky. We have a *number,* to be sure, and one that we can compare with numbers similarly derived from other countries; but, aside from affording facts for almanacs, I conceive that such a number has little significance biologically or scientifically. I want as my contribution to this discussion to point out how widely different in vitality the races of the United States are. And first, it is necessary to point out that for the most part we use the term race too narrowly. I will use it collectively for the possessors of a racial (*i. e.,* inheritable) character. Such are potentially members of a race; they may easily become actually such in consequence of a certain amount of isolation or inbreeding. To illustrate the fact that many traits that we think of merely as variations are really racial traits, we may consider eye color. If I ask a brown-eyed person whether he got his brown eyes from the mother's or the father's side of the house, he takes no umbrage at the inquiry and informs me if he knows. But if I ask an inhabitant of the island of Raratonga who prides himself on his race purity whether he got his brown eyes from the mother's or the father's side of the house, he feels at once insulted. His brown eyes he recognizes as a racial characteristic. As a matter of fact the brown eye color is a racial characteristic in both cases, but persons of European origin are used to the intermingling of the brown-eyed and the blu-eyed races that are found in this country, and forget the racial significance. Similarly, if I ask a colored man of our south whether it was from the father's or the mother' side of the house that he got his light color, he answers me without objection, but if I should ask any of this audience whether they got their white skin color from the father's or the mother's side, they would naturally take exception to the inquiry. All of our inheritable characteristics have, indeed, the essential traits of specific characters.

Beginning with the generally recognized races, as is well known the mortality of the negro is very different from that of the white. Thus, the census report gives the death rate among whites as 17 per 1,000 and among negroes 28 per 1,000, or nearly double, and for every 100 white children per 1,000 who die under 15 years, there are 150 negro chil-

dren. Now the interpretation of this result is not simple; in part the higher death rate of the negro is due to economic conditions that are, however, determined largely by racial traits; but, in part, it is probably due to the fact that the negro is not yet adjusted to the white man's civilization. Especially does this folk of jungle origin wither away in our large cities. Similarly, the death rate from tuberculosis is 3 times as great among our Indians as among the whites, and deaths from measles are proportionally greater among Indians than whites. Clearly the grand races differ tremendously in their vitality.

I know there are those who deny that there is such a thing as inherited resistance to disease. But there is at least a family liability to or immunity from various diseases, such as tuberculosis. It is easy to find in our records families in which 10 out of 12 or 14 deaths in a family have been from tuberculosis; as it is easy to find families of which none of the 10 or more members who have died have died of this disease, even when they have died at mature age, and, like practically every person, exposed to the disease. I think, then, we must recognize that non-resistance to tuberculosis is a family trait; and it may be characteristic of a whole locality, provided that locality (like southern California) has attracted many representatives of the non-immune race. We find indeed that, despite its salubrious climate, consumption is a much more common cause of death here than in most other sections of the country; and the high incidence of tuberculosis is found in the children and grandchildren of those who went to California for their health.

Again *cancer* is a disease whose rate of incidence varies in different parts of the country; it is highest in the state of Maine. Now, I have no doubt that this is due to the presence of one or more races in Maine which are non-immune to cancer. I know that many medical men do not respond favorably to the contention that there is a racial cancer diathesis in man. To be sure, it has been repeatedly demonstrated that such races occur *in mice* and such human families as we have studied yield the same result as the mice studied and indicate that *resistance to cancer* is a positive (dominant) trait and that non-resistance appears in the children only when both parents belong to a non-resistant race. And this result is commonest, other things being equal, where cousin marriages are commonest, because that makes it probable that if one parent belongs to a cancer race the other—the cousin—will belong to the same cancer race. Now in rural Maine, cousin marriages are extremely frequent—especially in the islands off the coast, and here we have the conditions for the result—the high incidence of numbers of the cancer race in an inbred community.

Again Huntington's chorea is a fairly common cause of death in certain localities, and it is a racial character as truly as are brown eyes.

For it does not skip a generation, and affects ordinarily half of the children of any affected parent. The vitality of Greenwich, Connecticut, like Suffolk County, Long Island, was formerly measurably affected by the presence in many of the old stock of that town of this racial characteristic.

Hemophilia, likewise, is, or was, a striking cause of death in certain localities, like a town of Sullivan County, Pennsylvania. It occurs in males chiefly, rarely in females, except in the case of the marriage of two persons who belong to the same race; and it ordinarily alternates in its appearance in the generations. It is an ordinarily sex-limited character. Its high frequency is due to the fact that persons with this trait settled in Sullivan County and have left descendants there.

It might appear from what I have said above that heredity has to do only with diseases or unfortunate mental conditions, but for every liability to disease there is resistance, and for every mental defect or weakness there is mental strength; and heredity has just as much to do with the reappearance of these strong characters in the offspring. I have laid most stress upon diseases, simply because we think so much in terms of them.

Now, in this brief address, I have alluded to instances merely where the death rate depends on the presence in the community of a disproportion of persons belonging to races that show immunity or susceptibility to particular diseases. I think it can not be doubted that most causes of death have, at least, an hereditary factor, and so we may draw the conclusion that the morbidity and the mortality of any community or commonwealth is to a large extent determined by the racial elements present there of general or specific resistance or liability to morbific agencies.

Finally, statistics tend to cover over causes. Indeed the statistical method abandons as hopeless the attempt to analyze causes and deals only with results. But what we are interested in is, after all, causes; and so far as possible the causes should be isolated and studied separately and, in this paper, I have laid stress on the importance of the racial element as a cause of variations in national vitality.

EFFECT OF THE WAR UPON THE RATE FOR CAPITAL

By CHARLES A. CONANT

NEW YORK CITY

THE most obvious effect of the European war in the field of finance is the rise in the rate of return upon capital. This is the natural result of the great destruction of wealth by the contending armies, which will have to be financed from savings which would otherwise be applied in meeting the usual annual demand for the extension and improvement of railway and industrial plants. It is evident, from the reports

received from time to time, that early estimates of a total cost for the war of fifteen billions of dollars for one year were not excessive. As the war has already lasted six months, there is little doubt that at least this sum would be consumed, even if peace should be made soon, because the armies could not be immediately disbanded and large contract obligations would, for some time, have to be met.

The amount usually available for investment in securities having a general market is shown by the computations of the Belgian financial publication, *Le Moniteur des Intérêts Matériels,* to be about $4,000,000,000 per year. This does not represent the entire sum of savings applied to the improvement and extension of private enterprises, some of which is represented by securities which are closely held, and some of which does not take the form of securities at all.

In dealing with the question how large a proportion of the total fund of capital available for investment will be absorbed by war loans, and how much can be diverted to its old mission of building up and extending the machinery of industry, there are many factors to be considered on both sides of the problem. Undoubtedly the patriotic spirit of the peasant, the mechanic and the small shop-keeper in France, Germany and England will lead them to dip into their little hoards of actual currency and other savings to make subscriptions to the national loans in amounts which would not be applied ordinarily to the purchase of railway and industrial issues. Undoubtedly, also, many sums which would be applied to improving and extending the facilities of the farm, the tool-box and the shop, will be applied to the purpose of saving the national credit and meeting the public obligations. From these sources will come considerable amounts which will be added to the net fund available for investment.

On the other hand, it can not be assumed that the entire amount which is available for investment will be applied to the new public loans. Where new capital issues are made essentially for keeping pace with industrial development, for enlarging mills whose product is in increased demand, and especially for meeting the growth of equipment for new population in the countries which have not been decimated by war, considerable sums will be applied to investments other than the national loans. This will be especially true of those small and closely-held corporations whose securities are distributed among the original holders and where the direct profit on the output makes the market rate for money a factor more or less negligible.

What part the railways will be able to play in wresting a portion of the world's savings from the outstretched hands of the powers which have been blowing away thousands of millions in powder and ball, becomes an interesting consideration. They must come into the open market and bid against the greatest states in the world for some scanty portion of the supply of investment capital.

In this connection, the fact must not be overlooked that the war has practically brought to a standstill, for the present, in many parts of Europe, any saving of capital for investment. If the war should soon end, and the men now employed in trying to kill each other were able to return promptly to the ranks of industry, a considerable stimulus would be given to the renewal of effective production, and a margin of savings for investment might emerge. On the other hand, there will be delay and considerable cost in re-establishing the important textile and other industries of northern France, of Belgium, and of other sections which have been the victims of hostile armies.

This great demand upon the world's saving for investment will make it difficult to obtain capital for industrial purposes except at a high rate. The credit of the strongest governments is usually at least ½ per cent. higher than that of private corporations. While England has succeeded in borrowing at a rate slightly under 4 per cent., Germany is paying 5 per cent. and France practically the same. The most severe pressure upon the market for capital is likely to be felt, however, after peace is made, during the distribution among investors of the large amounts of the loans which are being carried temporarily by the banks. This demand for capital will probably reduce the price of even the best bonds to the level of the new rate of return. Bonds might have a preference in certain cases over stocks, but, on the other hand, only those corporations which were able to pay a high return would be able to issue additional stock for the extension of their plants.

A high rate of return upon capital will not in itself be inconsistent with great industrial activity and certain types of commercial expansion. It is usually the experience after a war that the efficiency of labor is increased by the disposition to repair the waste of the conflict, and that the return of many thousands of men to peaceful industry not only restores, but increases the previous capacity for production. The prevalence of unusual economies also, both in Europe and the United States, will probably do something to offset the abnormal demand for investment capital for war purposes, and aid in the restoration of industry.

THE PREVENTION OF THE FUNDAMENTAL CAUSE OF WAR—DISCONTENT

By BYRON W. HOLT

OF WARREN W. ERWIN & CO., NEW YORK

BECAUSE of the very brief time (only two days) that I have been able to devote to this address, since I learned, on December 20, that I was expected to make it, I can do no more than to suggest, or outline, what if I had had sufficient time to prepare might have taken

more of the form of an argument or demonstration. If I do not succeed in proving my theorem as to the fundamental cause of war it will not be, in my opinion, because the facts, if properly marshaled, would not prove it, but it will be because I have not made a logical presentation of all the facts.

Only those who have given special attention to the subject realize either the extent and depth of the present discontent or the rapidity of its growth during the past fifteen or twenty years. Discontent of a virulent type had become practically universal before the present almost world-wide war began. It was manifested in the Balkan wars, the rebellions in Mexico and Central and South American countries, in the great and vicious strikes, and the political overturns of the last few years in this and in other countries.

Discontent, distress and disturbances had become well-nigh universal long before civilized Europe became a human slaughter-house. Socialism, progressivism, I.W.W.ism and other forms of radicalism have been in the air for years. Political and religious authority has been growing lax everywhere. Labor is grumbling and dissatisfied and is becoming less and less effective. Even our railroad officials are, or were, until recently, becoming anarchists, threatening to overturn our courts and commissions. They are almost ready for the government to take over their railroads—at fair prices, of course, which they assume are more than present prices.

I am not one who thinks that wars come by chance or accident. In my opinion there are causes, economic and vital causes, for all wars of consequence. These causes are not often in the foreground and are not usually the ones seen and discussed.

If opportunities to produce and exchange goods were open and free; if every producer got all that he should get; if there were no monopolists or takers of unearned increments to divide with; if, in short, no one got more and no one less than his just deserts, there would be no wars. There would then be no need of wars to right, or attempt to right, every 60 or 100 years, the accumulated wrongs of an unjust economic system.

It is because the economic foundations of most so-called civilized governments of to-day are unsound and rotten that our political structures are breaking down. That is why we have the present great war—a war centered in Europe but reaching to the remotest corners of the earth. It is because there are special privileges and special privilege takers and givers in Europe that millions of her bravest and best men are now killing each other. The share of the "grafters"—the land, tariff, patent and other special privilege grafters—became so large that production could no longer be profitably continued. The producers were in rebellion. They were voting for socialism and for other isms

inimical to the ruling powers in the monopoly and military-ridden countries of Europe. Rents, debts and taxes became unbearably high; that is why, in my opinion, there is now, in Europe, the greatest and most hellish war of all time.

The crowned heads of Europe, and particularly of Germany and Austria, saw economic and political disaster ahead. Their only hope of continuing in power lay through warfare and the capturing of surrounding territory on which tribute could be levied. In no other way could wholesale repudiation of debts be much longer avoided.

Discontent, widespread political discontent, and anarchy, are the forerunners of strife and wars, just as surely as happiness and contentment are the harbingers of peace and good-will.

Political discontent is the result of political or economic injustice. This injustice results from special privileges. If, then, we abolish privilege and establish political and economic justice, so that every man will have full political rights and will get and have no more and no less than his fair share of all that is produced, we shall have removed the cause of discontent and, therefore, as I believe, that condition of society that makes wars not only possible but probable.

As chimerical and Utopian as this proposition may sound, it is, in my opinion, not only eminently sound and practical, but will soon be the working formula for governmental action throughout the civilized world. It is, in fact, already dimly recognized by numerous of our most advanced governmental groups, such as those of New Zealand, Switzerland, Oregon and western Canada, and its principles are making some headway in the United States and Great Britain, and even in China, Japan and Mexico. The "New Freedom" of Woodrow Wilson means, and can mean nothing else than, the abolition of privileges and the establishment of political and economic justice. Gradually and not very slowly are our governments getting away from the feudal, hereditary class, and war-like theory of society and are being reorganized on the theory of equality, freedom and peace. This process may be expedited as a result of the present European cataclysm.

The Two Kinds of Special Privilege

There are two distinct kinds of special privilege—political and economic. The first relates to franchise rights and the second to property rights. When one man has a greater voting power than another, he has a political privilege. When one has greater property rights than another, he has a property privilege. Both forms of privilege are conferred by, and can, therefore, be abolished by governments.

Some of the worst forms of privilege were abolished by the Revolution in England, in 1688, by the Revolution in France, in 1789, by the Revolution in America, in 1776, and by the Civil War in the United

States, in 1861. The present revolutions in China and Mexico will almost certainly abolish some political and some economic privileges. The establishment of woman suffrage in some countries and states is abolishing one form of political privilege.

All political privilege will be abolished only when there is perfect equality of voting and legislative rights. To get these, we must have popular and democratic government, with one vote for each citizen of whatever race or of either sex. If we have a so-called representative government, it must be kept representative by the initiative, referendum and recall. The reins must always be in the hands of the people. The majority must always rule. There must be no hereditary rights and no constitution that can not be overturned, at the will of the living majority. Anything short of this is not full political equality and is inconsistent with the New Freedom.

There are two principal forms of economic privileges: (1) Restrictions on productions: (2) Restrictions on exchange of goods. Production is interfered with mainly by monopolies of the source of supply of materials or of the opportunities to produce. These monopolies are conferred by means of title deeds, franchise rights, leases, etc. We can ignore patent rights, for they are but temporary, and, theoretically, are intended to encourage improvements in machinery and thus to increase production, even during the short periods for which they run.

Probably the easiest and simplest way to abolish land and franchise monopolies, and thus to get rid of the privileges pertaining to land, is through government ownership of all franchise or public service corporations or monopolies, and by taking, for public purposes, the full economic rent of land. This can best be done by what we in this country call the Single Tax. The Single Tax simply takes for the public what the public produces—the so-called unearned increment of land—and, by taxing nothing else but land values, leaves to individual producers all that they produce. The single tax, therefore, conserves property rights to the greatest possible extent. It gives, in the most practical way, each citizen, from his birth, his full right to the use of the earth. Thomas Jefferson, Herbert Spencer and many other great statesmen and thinkers, from Moses to Henry George, agree that the earth, in usufruct, should belong to the living, and that the dead should have no control over it.

Exchange of goods is interfered with mainly through import and internal revenue taxes. Of these the import, or tariff taxes are, by far, the more important from a restrictive standpoint. They can be abolished by wiping them from our statute-books, in which case we should have trade as free and natural between countries as it is between our states and cities.

With full and equal political rights and with full and equal rights

to produce and exchange goods, every man would get all that he should fairly have and would hold it untouched even by the government. There could then be no undeserved or involuntary poverty and little or no individual class, race or national jealousy, envy or hatred. Each individual and each nation would benefit from all of the others and their mutuality of interests would promote friendship and good-will. No individual, race or nation will then have anything worth while to fight for or about. Under present conditions, there are many things to fight for, even aside from the rights of kings to rule or of nations to expand. It is true, however, that but few wars are waged for the rights of the masses. It is also true that but few wars are begun with the consent of the majority of the people.

It is reasonably safe to say that there can not be peace without justice. Until justice is established, poverty, crime, disease, jealousy, hatred and discontent will continue, and industrial, civil and foreign wars will be waged without end.

As civilization extends, commerce develops, cities grow, and land values increase, there is more and more need of taxing land values and of untaxing industry and commerce. Not only have municipal, state and national revenue needs increased so that, practically, they can not be met in any other way than by taxing land values, but human progress has, apparently, reached a point beyond which it cannot proceed until special privileges in land and in trade are abolished. From now on, times and things will be more and more out of joint until such changes are made. Even in the matters of health, hygiene and sanitation, we can not make much further progress until we tax land values and untax industry and commerce. This is the conclusion reached by Surgeon-General William C. Gorgas. "Poverty," he says, "is the greatest single cause of bad sanitary conditions."

Some such conclusions as these must be reached by the United States Commission on Industrial Relations, if its reports are to be of great value to us.

Gold Depreciation

It is undoubtedly true that the evils of special privilege have been accentuated and increased, temporarily at least, by the accident of gold depreciation. Gold has been depreciating rapidly for about eighteen years. Since 1896 or 1897, the gold dollar has lost about one third of its exchange or purchasing value. Gold is depreciating in value because its supply is increasing more rapidly than is the supply of other commodities. Its supply is increasing because, under the cyaniding and chlorination processes of production, first inaugurated about twenty-five years ago, gold is being produced much cheaper than ever before. The yearly output of gold is now four times what it was in 1890, and ten times what it was in 1860.

Gold depreciation accentuates the injustice of the present economic system of production and distribution in many ways; it causes prices to rise much faster than wages and salaries. It causes high interest rates and low prices for bonds and securities with fixed incomes; it causes land values to rise abnormally fast and thus results in giving the landlords of the earth a larger share of the world's goods; it causes wealth to concentrate even more rapidly than it would otherwise do; it makes business a gamble and increases speculation; it causes the cost of operation of railroads and of other public service corporations to advance more rapidly than rates and fares. In these and in many other ways gold depreciation increases unearned and, therefore, decreases earned increments. It is a most powerful revolutionary force in commerce, politics and society, and operates to increase discontent and radicalism.

Knowing of the injustice of our present economic system and seeing how this injustice was accentuated by gold depreciation, which was expected to continue for many years, I, nine years ago, in *Moody's Magazine,* made some predictions, about all of which have since been substantiated by facts. One of these was that, because of increasing costs of operation, the situation of our railroads would become so desperate that public sentiment would permit rates to be advanced. Another prediction was that the evils of gold depreciation would so disturb industrial and political conditions that overturns, wars, etc., would result.

Never, perhaps, in any previous period of the world's history were so many important, and frequently revolutionary, changes under way as at the present time. In former periods, we have had religious, political, governmental, commercial, financial and industrial changes at different times. To-day, that is, during the present decade, we see most important, even if sometimes silent, changes under way in all directions.

The present European cataclysm can not but result in great changes, governmentally and politically, and probably also industrially. Repudiation of debts, both public and private, is not only a possibility but a probability. Many European countries and cities were, by experts, considered to be hopelessly in debt at the beginning of the war. The billions and scores of billions of additional debts will almost necessitate repudiation. There is, in my opinion, only one possible escape from wholesale repudiation of public debt, at least by the losing countries, and that is through the public appropriation of the unearned increment from land. But the taking of land value for public purposes will depreciate land values to almost nothing, and will necessitate the repudiation of the billions of dollars of private and mortgage indebtedness in continental Europe, under the heavy load of which the masses of peasant farmers are now but little better than feudal slaves.

I hope that the Rockefeller Foundation, in its search for the causes

of industrial unrest, will not overlook either the land question or the gold-depreciation question. I am certain that it will not do so if it is earnestly seeking to remove the fundamental causes of unrest.

Summarizing, I will say that the present discontent is due, primarily, to great economic wrongs accentuated by gold depreciation—that is, by the high and rising cost of living and of doing business.

To right those wrongs and to bring peace and contentment on earth, we should:

1. Stabilize gold or adopt some other standard of value.
2. Take land values for public purposes.
3. Establish free trade between all countries.
4. Establish public ownership of all public utilities—railroads, street railways, telephones and telegraphs, electric light and gas companies, etc.
5. Liberalize our patent laws so that they will more promptly and fully benefit the masses and no less fully reward inventors.
6. Keep the initiative, referendum and recall in force at all times. Direct legislation not only safeguards the rights and liberties of the people, but is valuable for its educational features. It practically forces the voters to study public questions. It is as necessary in a republic as are public schools.

I am not alone in holding these views as to the fundamental causes of discontent and wars and as to how to remove them. It is true that not many of those who are now most in evidence in our newspapers and magazines are discussing what I regard as the real causes of wars. For the most part, they are putting the blame for wars on big armaments and military preparedness; on the desire of growing nations to expand, to have colonies, etc.; and on governmentalism or "monarchial governments," as Charles W. Eliot calls it. It is true that some of these writers mention popular government and free trade as possible preventions for wars, but very few of them lay stress on these ideas and still fewer mention or discuss the land monopoly as the greatest of all causes of discontent and, therefore, of wars. Only Free Traders, Single-Taxers and Socialists appear to have any comprehension of the real underlying causes of unrest and wars.

I will quote a few authorities on tariffs as a cause of wars.

Jacob H. Schiff, in his discussion with Charles W. Eliot, printed in the *New York Times* of December 20, said:

> The perpetual cessation of all war between the civilized nations of the world can, as I see it, only be brought about in two ways, both Utopian and likely impracticable for many years to come. War could be made only to cease entirely if all the nations of Europe could be organized into a United States of Europe and if free trade were established throughout the world. In the first instance, the extreme nationalism which has become so rampant during the past fifty years and which has been more or less at the bottom of every war, would then cease to

exist and prevail, and in the second event, namely, if free trade became established throughout the world, the necessity for territorial expansion and aggression would no longer be needed, for, with the entire world open on equal terms to the commerce and industry of every nation, territorial possession would not be much of a consideration to any person or peoples."

David A. Wells, in *Free Trade*, said:

A powerful argument in favor of free trade between nations is, that of all agencies it is the one most conducive to the maintenance of international peace and to the prevention of wars. The restriction of commercial intercourse among nations tends to make men strangers to each other, and prevents the formation of that union of material interests which creates and encourages in men a disposition to adjust their differences by peaceful methods rather than by physical force. On the other hand, it requires no argument to prove that free trade in it fullest development tends to make men friends rather than strangers for the more they exchange commodities and services the more they become acquainted with and assimilated to each other; whereby a feeling of interdependence and mutuality of interest springs up, which, it may be safely assumed, does more to maintain amicable relations between them than all the ships of war that ever were built or all the armies that ever were organized.

Richard Cobden said:

I see in the Free Trade principle that which shall set on the moral world as the principle of gravitation in the universe—drawing men together, thrusting aside the antagonism of race, and creed, and language, and uniting us in the bonds of eternal peace. . . . I believe that the desire and the motive for large and mighty empires; for gigantic armies and great navies—for those materials which are used for the destruction of life and the desolation of the rewards of labor—will die away; I believe that such things will cease to be necessary or to be used, when man becomes one family, and freely exchanges the fruits of his labor with his brother man.

Henry Ward Beecher said, in 1883:

The fundamental doctrine of Christianity is that all men are brethren. The fundamental doctrine of protectionism is that all men are not brethren. Christianity teaches that all men, in all parts of the world, should love each other. Protectionism teaches that all men on one side of an imaginary line should hate, or at least disregard, all who live on the other side of that line. Not only so, but protectionism teaches Christians to hate their fellow Christians more than they do pagans. We do not build up our tariff against heathen countries. . . . The moment the missionaries have, with infinite pains, taught the converted pagan to make anything fit to send to this market, we hasten to build up a high tariff wall to keep it out.

J. Novicoro, a great Russian writer, said, in 1903:

Freedom in the exchange of commodities alone can safeguard the interests of the nations. Since they are all interested in the inauguration of *the same* commercial policy, their solidarity is manifest and their supposed antagonism, in this particular matter of trade, is a delusion proceeding from the misapprehension of the *real* play of the economic forces involved.

Lord Kromer, Sir Lyon Playfair, Professor John Bascom, Professor William G. Sumner, Henry George, J. E. Thorold Rogers and other

eminent free-traders have expressed opinions similar to those quoted above.

I will close this rambling and, to me, most unsatisfactory address, with a few quotations from a most remarkable book published in 1850. Its title is "The Theory of Human Progression." Its author was Patrick Edward Dove, a learned Scotchman, who held that land rent should go to the state for the benefit of all.

> Where none has a legal right which is not accorded to another in the scheme of the state, the cause of internal strife is obliterated; and though governments go to war on very insufficient pretexts, populations seldom or never do so without a just cause. The obliteration of the cause, therefore, may fairly be expected to obliterate the fact. The feudal system, with all its modifications past and present, however mild or constitutional, is nothing more than systematized slavery. At the bottom of society there must always be found the great masses in a worse condition than nature intended. And wherever the feudal system exists, or any remnant of it, that system, or its remnant, creates a cause of war among the classes of society; which cause of war creates perpetual uneasiness, frequent agitations, and occasional revolutions. . . .
>
> God has constituted nature aright, and the only protection trade requires is protection from violence, and fraud, and state interference. . . .
>
> And first and foremost must come the question of the land. Suppose, for instance, it should be clearly proved, according to the science of facts (as some have termed economy), that it would be more beneficial to the whole associated community of Britain, to abolish all customs and excises, and all taxes whatever except a land-tax, which could be collected for nothing or next to nothing, what would political economy say in that case? Would it abolish all the taxes that interfere with trade, and thereby absorb the rents of the lands; or would it determine that a man with a parchment who does not labor, is to be preferred to a man without a parchment who does? From this dilemma political economy can not escape. There must be another system, one that can solve these questions by rule, not arbitrarily, but scientifically—by a rule that is general and applicable to all parties.
>
> And this new system is necessarily politics, or the science of equity.
>
> Political economy, in fact, is the natural preparative for a science of equity. . . . And thus, politics, or the science of equity, springs necessarily in chronological order out of political economy; and when economists have directed the state affairs up to those questions which they cannot answer, they must cede the first place to the true politicians, or themselves become true politicians. And when that period arrives the political evolution is complete, and there is the reign of equity or justice.

A MESSAGE FROM THE COUNTRY ON FOREIGN TRADE[1]

By the Honorable CHARLES H. SHERRILL

LATE AMERICAN MINISTER TO ARGENTINA

LISTEN to a message from the country: "Give new freedom to our railroads and our dying merchant marine so that they can aid our crusade for foreign trade, and permit American labor employers

[1] Address delivered before the annual meeting of the American Association for the Advancement of Science, Philadelphia, Dec. 29, 1914.

to combine abroad so as successfully to compete there against foreign combinations paying much lower wages." So audible is this message in all parts of our land that if there be legislators who have not already heard at least some of its wave sounds, then there must be something wrong with their political wireless telegraph apparatus, or, to drop into archaic phrase, "they haven't got their ears to the ground!" This message comes from an aroused country which has recently become aware of certain entanglements that it wants removed. Rip Van Winkle has awakened from his long repose in the Catskills of home trade, but the first few attempts to stretch himself have revealed that clinging creepers have grown about his limbs. Those creepers will have to go, and if the sharpness of existing legislative wits are not sharp enough to cut them, others will be found to do it.

The country from which this message comes is no longer a country where the farmer sees no further than his boundary fence, or the banker his local customers, or the merchant the home market alone. Not only have farmer, banker and merchant alike become students of foreign trade, but advanced students—they know both what they want and also the handicaps that hamper them, and they want those handicaps removed. And this message of theirs was learned by the writer from nearly two hundred chambers of commerce all over the country. It is surprising how much there is for a man to learn when once he gets away from the localism of Manhattan Island and comes into touch with that marvelous campaign for community-bettering now so vigorously carried on by the commercial bodies of our land. My message to them was of South America, the value of its friendship and of its trade opportunities, but the message they send back is of far wider import, deserving the attention of us all and especially of those to whom we have delegated the making of our laws and the conduct of our government. These chambers of commerce have now gone far beyond their old discussions of the need for foreign markets as a field for the expansion of our manufacturing, or as a balance to offset any temporary contraction in home markets. No, they are away beyond that. The study of the railroad rebate evil and its correction led them to learn that those domestic rebates were but trifles in comparison with the rebates given foreigners by the foreign shipping conference combine in ocean freights, which annually transfer from our pockets to foreigners six hundred million dollars for freight, insurance, etc., not only bleeding us financially, but also leaving the foreigners with the possession of the ships, and with their factories protected against our competition. Ten years ago if this statement had been made to a western grain grower or a southern cotton planter he would have replied: "I don't care, foreign ships are cheap ships, and I want my product carried cheaply." But now he knows better, he knows that when as a result of secret rebates to

foreigners, and of its so-called "fighting fleet" the foreign shipping conference combine drove independent vessels off the seas, carrying rates for grain and cotton, which in 1910, were, respectively, .03 and .12 were "readjusted" by 1913 to .10 and .45, respectively. He knows that the tribute he paid out of his profits to the foreign ships was trebled in three years, and that hurts! Therefore, and therefrom, he insists that our merchant marine be enabled to protect him from further extortion of that sort.

Nor have the leading men of the various communities who make up these chambers of commerce confined their study to American conditions, but have looked abroad and inquired into what other governments were doing to obtain more foreign trade for their nationals, and what did they find? They soon came to learn that many useful things done across the water by governments for the governed are here forbidden by our laws. Chief among those governmental aids to enterprising exporters abroad is reduced railroad rates to the seaboard given for exports, and the encouragement for firms which are competitors in the home market to band together for foreign trade. Their competition at home keeps down the home prices, but once across their national frontier they fight only foreigners and combine to do so. Now, with us a lower preferential rate on railroads for export articles is forbidden by the Interstate Commerce Act and the rulings of its Commission, while the Sherman Act interferes with combinations for foreign trade. All the foregoing is known to the organized activity of business men constituting these great commercial organizations. They have done everything possible to help themselves, but now they realize that governmental action is necessary to liberate our merchant marine from its present trammels, to release the over-regulated railroads from those regulations which prevent their assisting our exporters and to free our producers to make such combinations in foreign fields as they like. Give us this new freedom for our foreign trade, and American brains and energy will soon get for American labor and capital what has been so long going to foreign labor and capital.

Of these three great and immediate reliefs now so widely and so earnestly desired by organized business men the two mentioned last are the more easily obtained. Laws could speedily be enacted, one modifying the Interstate Commerce Act so as to permit railroads to grant preferential rates on goods to the seaboard intended for export, and the other amending the Sherman Act so that it shall be lawful to make combinations for trade outside our borders. As to the third point, the assistance of our merchant marine—it has been so much discussed that it has come to seem a difficult problem, but is it? Let us see. We carry only 8 per cent. of our foreign trade in American ships and we have to pay any rates for the rest of it that the foreign shipping combine

decide upon. We all want to get back to some such laws as were put on our statute books in 1789 by Washington, Madison and Jefferson, at a time when our ships carried but 23 per cent. of our exports and imports, and which laws by 1800 had already raised that percentage to 89 per cent., and by 1810 to 91½ per cent., at the same time giving us a merchant marine that won for us the war of 1812. In 1828, when we were carrying 89 per cent. of our trade, the agricultural south and west combined against the shipping interests of New England and passed the Reciprocity Act of 1828, opening our trade to foreign competition, whereupon there at once began a loss which has now shrunk our total down to a paltry and shameful 8 per cent. A democratic southern President, Polk, seeing the success of English subsidies in the then new steamship trade, followed their example and soon our success in steamships was rivaling our earlier success in clipper-built ships, but the bitter sectional quarrel between south and north in 1856 caused the southerners in Congress, led by Jefferson Davis, to strike a blow at the shipbuilding north by repealing the mail subsidies. It succeeded. Thank God that quarrel and its cause no longer exist.

To-day the cotton-growing south and the grain-growing west are as alive as the northeastern seaboard to the need for freeing our merchant marine from the meshes of the net that is strangling it.

Everybody wants our merchant marine assisted—it was promised by all parties in the campaign of 1912. What happened after the election? The democratic party in control of both branches of the Congress and of the executive enacted the tariff law of October 3, 1913, and in it put a section granting 5 per cent. reduction in duties to goods carried in American bottoms. Sundry foreign governments promptly filed protests with the State Department. These foreign governments had long been planning to prevent any return by us to the laws which succeeded so brilliantly in the early days of our republic. Thanks to certain secretaries of state more eager to perpetuate their names on treaties than to learn the history and policy of their department, those foreigners succeeded in weaving a web of treaties which in the opinion of the Attorney General of the United States (rendered October 31, 1913, to the Secretary of the Treasury), nullified all that part of the act which attempted to assist our merchant marine. And that was the end of it? No, it was only the end of that chapter, for the people of the United States waked up for the first time to the fact that constant vigilance must henceforth be given to what contracts our State Department makes with foreign powers. We now insist on knowing if good bargains are being made for us, so flagrantly have many of our diplomatists been outwitted in the past, as witness this mesh of treaties that seem to leave us powerless to do what Washington, Madison and Jefferson did in 1789.

But are we helpless, and are we outwitted? Let us look at these treaties, and see if anything could be added to the said opinion of our Attorney General. We shall find that almost without exception each of them contains a clause permitting either party at his pleasure, upon a specified notice generally of one year, to terminate it. No breach of treaty or of contract is necessary to terminate the treaties recited in the Attorney General's opinion. To serve general notice that unless these treaties are so modified as to give us back the freedom of 1789 we intend availing ourselves of their abrogating clauses would gain us respect from those very foreign chancelleries which to-day laugh openly over their success in catching our merchant marine in their net of treaties. It would be both interesting and useful for us to learn which, if any, of those chancelleries would decline to make such modifications, and thus force us to serve the required notice upon them! The Democratic party loves to quote Jefferson, and all parties to quote Washington—very good, let them, once freed from our present plight, join in re-enacting the laws which those two early statesmen put on our statute books. Fortunately we are not here confronted with a question like that involved in the Panama Canal Treaty—in that treaty there was no abrogating clause, and we will live up to that bargain in which England got so much the better of us, cost what it may. England will live to regret that treaty, or else she will wisely consent to its modification. Parenthetically, is it not the duty of our government, the very next time England asks a favor to exact, as a condition to granting it, that the Hay-Pauncefote be so modified that we can do what we like with the canal built by our brains and our millions!

This message comes from no youthful debating societies, nor is it prefaced by the word "please"—it comes from thousands of men, full grown in their heads as in their bodies, business men who have organized to protect their rights and to get what they deserve, and who have come to know of certain impediments thereto which they properly expect to have removed by the government which they themselves elected. No untried remedies are being sought—two of them have been successfully tested by the German Government and the third by our own dear country under the guidance of Washington and Jefferson. Here is the message—but what will our government do about it?

THE EXTENSION OF OUR MERCHANT MARINE

By George W. Norris

Director of Wharves, Docks and Ferries, Philadelphia, Pa.

THE subject which has been assigned to me for discussion this afternoon is "The Extension of our Merchant Marine." With all respect I would suggest that "The Revival of our Merchant Marine"

would have been a truer and more appropriate title. By whatever name we may choose to call it, the subject is one of tremendous importance—of such importance that, while I am glad to have the opportunity of presenting it, I hope and trust that it may be discussed in many other forms; that my very imperfect presentation may be supplemented and improved; and that these discussions may go on until we reach a real and practical remedy for the present deplorable conditions. One of the most notable of Sir Walter Raleigh's many notable aphorisms was his declaration, "Whosoever commands the sea commands trade. Whosoever commands the trade of the world commands the riches of the world, and consequently the world itself." That statement is as true to-day as it was when he made it. The converse of the proposition is equally true—that whosoever does not command the sea, trades at the pleasure of others and contributes to the wealth of others, who will in time command the world itself. Never has the world had such an object lesson in the value of "command of the sea" as is afforded to-day, when the industries and commerce of England continue in an almost normal way in the midst of a war for national existence, while Germany's commerce has been banished from the seas and her vessels are tied up in all the great ports of the world, her exporters are idle, her looms are silent and her people must economize in their use of foodstuffs to avoid the danger of ultimate starvation. You may say that this is a question of a navy rather than of commerce, but I would have you note that the two are inseparably related. An adequate navy must include colliers, transports, supply and hospital ships and scout cruisers, as well as battleships, torpedo boats and submarines. There must be ship-yards for construction and repair work, and there must be a reserve of men trained to the sea, to meet the added demands and losses of war, and unless there is a merchant marine you can not have these things. Ship-yards can not live on the construction of battleships alone. Confine them to that, and war will find you without ship-yards, without trained artisans, without an adequate supply of auxiliary ships, and without facilities for manning such ships as you might otherwise be able to put in commission. Leave out the question of national defense, and look merely at what our position would be if, instead of an undisputed mastery of the sea by England, there was an even distribution of sea-power and England, France, Germany and Austria were all preying upon each other's commerce, and goods could not be shipped with safety in the vessels of any of those nations. We produce about 42 per cent. of the world's pig iron, nearly 25 per cent. of its wheat, over 40 per cent. of its coal, over 70 per cent. of its corn, and 60 per cent. of its cotton. A great deal of our production of these articles we export—two thirds of our cotton and nearly a quarter of our wheat, not to speak of 32 million barrels of petroleum annually—and with

these exports we pay a large part of our annual charge of 600 to 800 millions due to the rest of the world for interest, dividends, freights, and payments and remittances of various kinds. If there were no ships in which these goods could be exported, what pen could describe the financial and industrial chaos in which we should be plunged? Think of the point to which wheat would drop. Think of the iron furnaces out of blast, the mines closed down, the farmers ruined, and our gold-supply exhausted, unless universal repudiation were enforced. The picture is too horrible to contemplate, and yet, like a drunken man dancing on a tight rope, we go on relying upon the Providential mercy which has thus far preserved us from such a national catastrophe. This is no figure of rhetoric, or over-drawn picture. It is a self-evident peril, which stares us in the face and to which only fatuous folly will seek to close its eyes.

But have we no ships, you may ask? Oh yes, if you will refer to the last issue of Lloyd's Register you will be gratified to find that the American Merchant Marine comprises 3,100 vessels of over 5,300,000 tons gross register, and these figures are the narcotic which has lulled to sleep so many of our statesmen and business men and economists. But if you will analyze these figures, and subtract the vessels which ply only upon our lakes, rivers, bays, sounds, or canals, and which are either absolutely imprisoned on our inland seas, or otherwise unavailable for ocean transportation, you will have left only 361 vessels of a gross tonnage of 1,375,000 tons to represent our ocean-going American Merchant Marine, and even from that paltry remnant there should probably be a further deduction made on account of vessels which, owing to their limited size, are not commercially available. The available ocean-going marine is therefore just about equal in tonnage to the fleet of one single German company. Put in a different form, whereas in 1861 over 65 per cent. of our foreign commerce was carried in American bottoms, in 1901 only 8 per cent. was so carried. To-day our foreign commerce represents about one eighth of the world's total, and not more than one tenth of that one eighth, or 1¼ per cent. of the world's commerce, is carried in American bottoms. For the carriage of the other nine tenths of our foreign commerce it is estimated that we are paying to the ship-owners of other nations in ocean freights and passage-money from $200,000,000 to $250,000,000 a year. This is a direct loss, and takes no account of the profits we might make if, like other nations, we engaged in the business of transporting goods other than our own. By the neglect of this business it is therefore evident that we are not only (*a*) losing these last-mentioned possible profits, and (*b*) paying this enormous and killing charge, but we are also subjecting ourselves daily to the frightful risk of an utter paralyzation of our whole foreign trade.

Having thus outlined present conditions, it may be pertinent to refer very briefly to the causes which have brought them about. In the early days of the nation nearly all of our foreign commerce was done in American vessels—in 1821, for example, 89 per cent. of it. Up to the civil war there was a slow but steady decline, the proportion being 86 per cent. in 1831, 83 per cent. in 1841, 73 per cent. in 1851, and 65 per cent. in 1861 (fractions omitted). Then came a rapid drop—32 per cent. in 1871, 16 per cent. in 1881, 12 per cent. in 1891, and 8 per cent. in 1901. With all the tremendous increase in our foreign trade in the last fifty years, the American tonnage carrying it is now only 40 per cent. of what it was 50 years ago. What is the explanation? The size of vessels had been increased, and iron and steel had taken the place of wood in construction. Instead of being built in a sort of local cooperative way, the construction of vessels had become a specialized form of industry. Construction had been subjected to the inevitable results of our protective tariff policy, and operation had been subjected to both these results and to the effects of our Navigation Laws. We had made ships about 60 per cent. more expensive to build in American than in foreign ship-yards, and from 20 per cent. to 35 per cent. more expensive to operate after they were built. Having thus bound a ligature around each leg of our Merchant Marine, we have watched the legs atrophy, and have for forty years confined ourselves to eloquent regrets that our bound and shackled victim did not run and dance, and to expressions of fervid hope that he soon would. We can grant a monopoly of coastwise commerce. We can give a practical monopoly to a public utility company, or a limited monopoly to a line of land transportation, but, on the broad ocean, which is the highway of all the world, there can be neither monopoly nor preference, by nation, race, or creed. There all comers meet on equal terms, and "the race is to the swift, the battle to the strong." In that unrestricted competition the weak, the overburdened, and the handicapped can not even hope for success. Is it not about time for a people as intelligent as the American people to alter their attitude upon this all-important subject? There are certain economic or industrial changes which could be made to advantage. I believe that the high cost of vessels built in American ship-yards is largely due to the fact that they are finished with an unnecessary degree of elaboration, and that there is an utter lack of standardization. An ocean "tramp" built merely to carry bulk freight does not need to be highly finished. She should be strong and seaworthy, but neither speed nor appearance is material. Many of the modern freighters constructed abroad are mere steel boxes, pointed at the ends, with an engine, a propeller, and a rudder. Our lake-freighters are sometimes described as being "built by the mile and sold by the foot," but their effect upon transportation costs has been little short of

marvelous. In the memory of living men it used to cost 32½ cents a bushel to bring wheat from Duluth to Philadelphia. Last fall it was brought over the same route for 6½ cents a bushel. Grain has been moved from Duluth to Buffalo for 1 cent a bushel, and coal and iron between Superior and the lower Lake ports for 40 cents to 50 cents a ton. There is no reason to doubt that what these freighters have accomplished in lake transportation, and what a great Detroit manufacturer has done in automobile construction may be, to a great extent at least, duplicated in ocean transportation. Standardization is the secret, but standardization is only effective when it can be applied on a large scale, and what opening, it may be asked, is there for it when, as at present, there is practically nothing to standardize?

This brings me to a discussion of some of the remedies which have been suggested by individuals or organizations interested in the subject. Among these suggestions are the removal of duty on materials entering into the construction of vessels; the admission to American registry of foreign-built vessels; subsidies; and various modifications of the navigation laws. It is perfectly evident that, as President Wilson said in his last message to Congress, "To correct the many mistakes by which we have discouraged and all but destroyed the merchant marine of the country, to retrace the steps by which we have, it seems almost deliberately, withdrawn our flags from the seas, except where here and there a ship of war is bidden carry it or some wandering yacht displays it, would take a long time and involve many detailed items of legislation, and the trade which we ought immediately to handle would disappear or find other channels while we debated the items." American shipbuilders are already handicapped by the higher cost of materials and higher wage scale which they have to meet, and to admit foreign-built vessels to American registry as a regular and permanent thing would probably be a fatal blow to the ship-building industry. The admission of ship-building materials free of duty would be wholly inadequate to meet the situation. Many people have argued for many years in favor of subsidies, which have been suggested to successive Congresses in many forms, sometimes undiguised, and sometimes disguised as payments for carrying the mails, or as a guarantee of the bonds of private corporations, or as a government loan to a private corporation. It is a well-known fact that the democratic party is opposed on principle to subsidies, either disguised or undisguised, and as it was never possible to get any form of subsidy through a republican congress, it is scarcely worth while to consider the possibility of its getting through a democratic congress. Any attempt to modify the existing navigation laws will certainly be opposed by the Seamens' Union, supported by all the other labor unions, and reinforced by the enthusiastic advocates of the "safety at sea" idea, whose cause has been so much strengthened by

the series of startling marine disasters which have shocked the world within the last few years. It is, therefore, evident that any changes that will bring the cost of either building or operating vessels down to the foreign standard must be very radical changes, and will inevitably be opposed by very powerful interests. I do not mean to say that no attempt should be made to effect such changes. American ingenuity and adaptability have been able to make a success in many lines of industrial activity where foreigners had distinct initial advantages, and I believe that we should find means to overcome in ocean transportation some differences in cost of both instruction and operation, and that changes might ultimately be accomplished which would make it possible to overcome the handicap. It is too evident for argument, however, that the accomplishment of any such result will be tedious and difficult, and that the present conditions should not be allowed to continue for the years that must elapse before such result could be reached.

The pressure of these facts and conditions has been felt in congress, and at the last session several bills were introduced aiming at either the development of the merchant marine or the provision of auxiliary vessels for the navy, or both. There were hearings before the House Committee on Merchant Marine and Fisheries at which these bills were discussed quite fully, and majority and minority reports were submitted from that Committee. At the present session a new bill has been introduced by Senator Stone which was referred to the Committee on Commerce, and has been favorably reported from that Committee. This bill creates a "shipping board" consisting of the Secretary of the Treasury, Postmaster-General and the Secretary of Commerce. Subject to the direction or approval of the President as to its more important functions, this Shipping Board is authorized to subscribe to any part, not less than a majority, of the capital stock of a corporation undertaking the purchase or construction and subsequent operation of merchant vessels to ply between ports of the United States and the ports of Central and South America, and perhaps elsewhere as necessary to meet the requirements of commerce. It is further provided that government bonds up to $30,000,000 may be issued for the purpose of purchasing or constructing vessels to be sold to such corporation, payment therefor being made in bonds of the corporation. This bill contains a further provision authorizing the President to lease or transfer to such corporation not only vessels purchased or constructed under the provisions of the Act, but also such naval auxiliaries as are suitable for commercial use and not required for use in the navy in time of peace. It is further provided that vessels purchased or constructed under the act shall be, as far as possible, suitable for use as naval auxiliaries and that the government shall have the power to take them for naval pur-

poses at any time. This act, and a similar one introduced in the previous session, have been criticized in many quarters. Some persons regard them as "paternalistic," and others brand them as "socialistic." Some object to the idea of using public money to run steamship lines at a loss. Some persons given to seeing ghosts can only regard this as schemes to buy the German steamers tied up in our ports; while to others the specter assumes the form of "an entering wedge to government operation of transportation by land as well as by water." Others oppose them because they believe the navigation laws should be changed. Others because they believe that the proper remedy is in subsidies to privately owned and operated lines. Both these last classes are unwilling that the patient should be cured by any other remedy than their own—although they will probably admit that there never was a time when the acceptance of either of these remedies was so unlikely as just now. As to the idea that the adoption of such a measure would be a precedent for railroad operation by the government, or would in the slightest degree pave the way to any such result, I can imagine nothing more unlikely. The conditions which exist in ocean transportation, and the theory upon which governmental intervention must be justified, are so wholly different from the railroad situation, that there can be neither analogy nor comparison between the two. Moreover, as the governmental intervention would probably be temporary—ultimately yielding the field to private capital—and would probably show a balance on the wrong side of the ledger, opponents of government ownership of railroads should rather welcome the experiment as likely to prove an illuminating object-lesson. The bill authorizes the shipping board to "purchase or construct" vessels. While much-needed orders would quickly be given to our ship-yards, no doubt, pending construction, some vessels would be either purchased or chartered, to take care of the present trade emergency, and it is quite possible—perhaps likely—that some of these would be German. Does this detail damn the whole proposition? The other objections—paternalism, socialism, and the use of public money in a probably non-remunerative enterprise—all involve the same principle. Men always have differed, and always will differ, as to just what functions governments—national, state or municipal—should undertake. Leaving out the extremists at both ends, I think it may be said that a very large majority of our people are of opinion that government should provide all those things necessary to the health, safety and comfort of the community which private capital does not and will not provide. Where private capital might do it on certain terms, or where private capital is doing it and there is a dispute as to the efficiency of the service or the fairness of the rates and terms, there is always and necessarily a wide field for argument. But where the thing is necessary, and private capital has not undertaken, and will not undertake,

to supply it, there is substantial agreement that it should be supplied by the community itself, acting through its constituted authorities. I am not attempting to state this with scientific accuracy, or in the phrase of the political economists. I am only endeavoring to state what I believe to be the plain opinion of the plain people. They have acted on this principle repeatedly, and in many localities. To take two conspicuous illustrations: It brought about the construction of many miles of municipally built and municipally owned subways, and it has created harbor improvements whose cost run into the tens of millions. Cities went into these enterprises, either alone or in association with private capital to which preferential terms were given, knowing that the direct return upon the investment would not be adequate for a period of years, if ever, but knowing also that they were essential to the health, comfort and development of the community; that they must be provided; and that they could not be provided in any other way. I maintain that the entry of the federal government into ocean transportation is justified on exactly similar grounds.

Let me review the facts:

Fact One.—We have (practically speaking) no vessels in which to send out our 2,500 millions of exports, or bring in our nearly 2,000 millions of imports. Because of this fact, we are (1) destroying the efficiency in war of our navy, (2) fattening the rest of the world by an annual payment of $200,000,000 or more, (3) hampering our manufacturers and exporters by compelling them to ship through their competitors, and (4) running the risk of an utter paralyzation of our foreign trade by a war to which we are no party.

Fact Two.—Under existing conditions it is capable of mathematical demonstration that private capital can not and will not supply such vessels.

Fact Three.—These conditions can not be materially changed without such radical and fundamental changes in our policies as could only be brought about —if at all—through an educational propaganda continued over a period of years.

Fact Four.—The federal government can fill the void at a direct cost which can not be more than a very minute fraction of the indirect benefit.

Believing in the absolute truth of these facts, I am strongly in favor of trying the experiment. I believe that the lines established by the government will greatly aid our exporters, and thereby simplify the problems of our bankers; that their operation will develop trade to a point where, within a few years, it will be possible for private capital to take some of them over; that the facts learned, and the experience gained, will pave the way for such changes in the laws as will permit private capital to enter the field; and that thus there will come about, under governmental initiative, that general revival of the American merchant marine about which we have all been dreaming for a generation, but hitherto failing to translate our dreams into action.

THE WAR AND FOREIGN TRADE

By H. E. Miles, Racine, Wis.

Vice-President of the Association of Manufacturers

We of the United States are nothing if not trade-getters and trade-makers. Within our boundaries are forty-eight separate states and commonwealths, with great diversity in tastes, habits and requirements. Within these boundaries has been developed the greatest volume of trade and of production, both agricultural and manufacturing, of any nation in the world, by far the greatest accomplishment being in the single generation just passing.

The small manufacturer is constantly adding another state or territory as his factory grows and trade expands. He "takes on" Texas, New England or Wisconsin. He is thoroughly accustomed to meeting the special requirements of a district new to him as respects goods, credits and trade customs. He is indifferent whether the distance is a hundred miles or two thousand.

I can not accept the often-repeated statement that the American manufacturer lacks adaptability; that his attitude toward any market he cultivates is that of "take it or leave it." Fashion is fickle in the United States; invention is inconsistent and startling. Wherever either have extensive play, or territories vary in their demands, American manufacturers are chameleon-like in their easy and quick adaptability. It is so much a cardinal principle with them always to have "something new" that the trade has almost come to demand "something new" even if not so good as the old. I know many factories into which samples are frequently brought and perfectly duplicated. When the American manufacturer refuses to change his patterns it is because it will not pay to do so from the evidence in hand.

Nor need we talk longer about packing, as if all South America, for instance, would be at our feet if only we would pack our goods acceptably. Only yesterday I heard of an American shipment that slid down a mountain side without damage to package or contents. Packing must be paid for, like any other service, and the American who makes good goods is very thoughtful of his packing. He has only to know what is needed in any foreign market, as some now do, and as all do in the home market.

In short, the American has only to put his mind upon the foreign market with that intensity with which he has developed the home market near and far and in all its aspects, when he will be in the way of making himself at home and his customers happy wherever it will pay so to do. The question is rather where will it pay now and what can be done to make profitable such other trade as we are not now entitled to in those products in which for any reason Europe excels us, and in what manner shall we go about the problem.

Our great corporations have led the way in masterful fashion. They have the resources in men and money to master any problem. It is, however, neither fair nor wise to leave each manufacturer however small, to seek foreign markets individually and unaided. The one supremely great American corporation, the government itself, must do for the innumerable smaller manufacturers what our greatest corporations alone are able to do for themselves. We must follow the example of Germany and other of the more successful European countries.

May I illustrate by a personal experience? For years I have been provoked or amused by government and other bulletins announcing that some lone firm in the Argentine, or South Africa, wants a plow or a wagon. Knowing that a plow perfectly adapted to one district may be worthless a hundred miles away; knowing of thousands of dealers in this country who want plows and just what specifications are needed in each case; with full information at hand as to financial standing and other particulars, I have no sufficient reason to interest myself in this lone individual on the other side of the world and I take no chances of annoying mistakes and failures.

There are two or three hundred implement-makers in the United States. Working as they do in the greatest agricultural country in the world, they rightly excel all others in inventive skill, as is partly evidenced by their present exports and by their government estimate that the American crops are produced at a saving of $700,000,000 annually over the cost of raising a like crop of fifty years ago. Our implement manufacturers are driving men off the farms by labor-saving machinery faster than intensive cultivation is bringing them on. This is one reason, but only one, why our population is increasing relatively much faster in the cities than in the country. One of these implement manufacturers wisely sent to the Argentine his most trusted designer and shop man. He secured splendid orders and perfect specifications, with one fatal exception. He failed to note that the plows were drawn from the foreheads of oxen the "hitch" being around the base of the horns. Consequently the plows were pulled out of the ground and the company lost the entire shipment and hundreds of dollars besides, and only with difficulty retained the good will of its customers. It is such experiences that bring upon us the many criticisms about packing and "making what the customer wants."

I have said we must follow the European example. There are only four very great manufacturing nations; England, Germany, France and the United States. Of these four the United States is the greatest in the volume of its product and, in my judgment, even in adaptability and grasp, but the other countries are organized for foreign trade, while we are not. Generally speaking, we have not wanted it. We have legislated to hinder and prevent it rather than to develop it. We have,

therefore, now a reputation to overcome as well as a reputation to establish.

Germany faced the problem, when almost without foreign trade some forty years ago, with a thoroughness born of extreme need and a wonderful appreciation of opportunities. She organized, through governmental and trade agencies, for trade, even as she organized her fighting forces of war. She sent out, at government expense, as the agents of all the people, to develop her industries, her payrolls and her wealth, men carefully chosen from the respective trades into each of the great foreign markets. These men made exhaustive studies of the requirements of each market. They sent home samples of goods used, together with lists of responsible buyers and quantities purchased. These samples were placed in commercial museums; the information distributed, sometimes very freely and at other times confidentially, where it would do the most good. Our governmental agency for this work is naturally the Department of Commerce and its Bureau of Foreign and Domestic Commerce. Following the German example, it is for this department to discover precisely what farm implements, for instance, are used in the Argentine; to secure samples and place them, for example, in the Field Museum in Chicago, the center of the farm-implement industry, where the makers frequently gather from all parts of the country. Imagine the change of attitude of the men who have been careless of the single distant individual who wants a plow, when these men can take their foremen and others to Chicago and there see exact samples of various tools and learn fully of buyers who all told use $50,000.000 annually of these tools. Such information visualizes vividly an entire market and delightful opportunities. It leaves the very minimum of hazard as respects packing or any other feature. The single government expense is utterly inconsiderable as against the individual expense and the hazard of mistakes if each of two hundred manufacturers is to go by himself for this information.

With such information as a basis, there would be need of restraint rather than of encouragement as the American industry goes after the market thus disclosed.

The Department of Commerce after this fashion sent an expert in the cotton trade to China some years ago. He sent home 5,800 samples with a world of definite, necessary information, with many surprises. Among other things England had been sending millions of yards annually of an extremely thin and open cotton fabric loaded with sizing that gave it apparent weight and character. Some of our manufacturers had felt too proud to make anything that seemed to them so valueless. It was disclosed, however, that this cloth was for only two purposes, to clothe the dead and to wear next the skin to prevent the scratching of the very coarse outer garments worn by the poor. Our cotton makers were greatly stimulated, but for a time unable to take

full advantage of the information because of the Boxer uprising and the boycott of American goods. There are, however, a few American factories running exclusively on cotton goods for the Orient.

So the Department of Commerce has been eager for years to give this service and has been giving it in such very limited measure as its funds permitted.

We may take a lesson from the Department of Agriculture. When Secretary Rusk succeeded Secretary Morton in this department, he first looked the department over and said to Secretary Morton, "What is the good in all this, anyway, Mr. Secretary?" to which Secretary Morton replied, "Why, you've got the appropriations." The department was in its infancy. There seemed little to do but distribute the funds. It has grown, however, until it uses with great wisdom $17,000,000 annually, and $4,000,000 of this amount for purely development work, searching out new cereals from all over the world, studying soils, fighting pests, and in the most intimate way serving every last farmer in the land. And it gets a thousand times better returns on this $4,000,000 than it ever got on the little sums appropriated in the earlier days. So the vision has come to the Department of Commerce and to its friends throughout the country. It can give no service to American manufacturers, but the service is of value to all other citizens. Against the $4,000,000 given the Department of Agriculture for purely development work the Department of Commerce until recently was given only $40,000, but recently, with no thought of war but solely of the general welfare, Congress gave to the department $50,000 to lead in the development of the markets of South America with their annual imports of $1,043,000,000, of which we have been favored with only seventeen per cent. So it gave the department $100,000 with which to develop the trade of all the rest of the world with its annual purchases of some three and a half billions of dollars, and another $100,000 for the establishment of some fourteen commercial attachés in the great capitals of the world.

There is no American but wishes that the present war would stop to-morrow, and it is well to note that the vision came to us of foreign opportunities and of the demands that foreign trade may properly make upon us before there was any thought of war. The present Secretary of Commerce and all with whom he cooperates have long cherished the vision and begun the larger development in such excellent manner as may well make Congress wish to extend the appropriations as fast as the department, with its conservative judgment, will ask for them.

In similar spirit and with the same vision, substantially, all of the business organizations of America, large and small, cooperated in the establishment of a central organization, or clearing house, known as the Chamber of Commerce of the United States, and in this central organization, with its headquarters in Washington, American business two

years ago found itself, nationally and internationally. So far had this new movement developed that President Wilson said of it last September:

> This furnishes acceptable proof to the country that the antagonism between government and business has disappeared and that there has come upon business the spirit of generous rivalry and cooperation, which is the essence of statesmanship.

The business men of Germany, of England, and other successful countries. perform a very great part in governmental, economic and social development. It is only by this union of the elements of practical experience with philosophy and sociology that the best national development is possible. The future historian will probably find nothing of more consequence in our present history than this new spirit with which business cooperates, as in other countries, in true greatness of spirit and vision with the forces of government and society. Its effect upon the foreign trade is of supreme consequence.

When government and business cooperate as government and agriculture have, we shall visualize foreign markets, measure them, and go after them with a degree of intelligent service and enlightened accomplishment that will be as helpful and satisfactory to the foreign buyer as to ourselves.

The Tariff.—We must be friendly if we would have friends. The American tariff for generations has been made for the purpose of preventing imports and decreasing foreign trade. Taking us at our clear intent, substantially every other country, free-trade England excepted, has made a target of our trade. Needing revenue, wherever there was a choice the foreign country has, even though unconsciously at times, made its rates high on our products and lower for countries that courted its good will. Repeatedly, foreign countries have evidenced a willingness to reduce their rates on various American products whenever we would be fairly reasonable in reducing our rates on their products, Germany, for instance, offering to lower her rate on our bacon, and materially to modify her restrictions on our beef under which she was, and is, prohibiting its importation, greatly to our detriment. For the American eats willingly only the choice cuts and one fourth of the beef carcass. These would be much cheaper could we favorably market the poorer cuts in countries that want them, these poorer cuts including, as they do, three fourths of the animal.

One of the strangest things in our history was the McKinley Bill and the purpose that actuated McKinley in its making. Said Colonel George Tichenor, general appraiser, who framed the bill under McKinley's direction, as he later did the Dingley Bill, in a letter to Mr. Dingley:

> The controlling idea in the preparation of the McKinley Bill was to dispose of, and prevent, the accumulation of surplus revenue. It was in that view that

duties upon certain articles were made prohibitive, upon others higher than they otherwise would have been.

In truth, McKinley did not decrease the revenues; the people paid more than ever before, but the major part of their payments was diverted by the McKinley Law from the public treasury, into the coffers of the great combinations and trusts which that law "mothered." I say "mothered" because when McKinley prohibited imports of manufactured necessities, and made other imports very difficult, he permitted, if he did not invite, home producers to combine and consolidate as they did with excellent business judgment and fateful consequence. Think of the good roads, conservation, waterways, and many other blessings that we might have had with the moneys McKinley was afraid to receive, and unwittingly diverted. Think of the ill-will and lack of respect other nations had toward us. The Dingley Bill was no lower. This is mentioned only to indicate the just prejudices we have to overcome, and the need of doing so quickly.

In international trade the first bargain is properly the tariff bargain that opens doors and makes entrance easy. Our present tariff has done away with ill-will. It is honest, but it was made so hastily that there was no time, even if there was thought of, securing the many concessions that had long been waiting for us. Any other of the nations we emulate would think itself insane to make its tariff inconsiderately, or without most exhaustive study and bargaining. It is impossible that we shall long fail to do so. We must study and negotiate with each country exhaustively, and admit such of its products as we can use to advantage at the same time that we secure the best possible terms for such of our products as she can use. For we must buy if we sell. Just as we must pay for our imports by our exports, and in addition pay hundreds of millions of interest and dividends on our securities held abroad, so other nations must export to us very largely if they buy from us largely, and the newer countries must export more than they import. We must, with extreme good judgment and care, ascertain just what we can buy without hurt to our home products, at the same time that we induce the foreigner to buy from us all that he can without hurt to his own production. This means that there must be established a tariff commission (call it by some other name if you will), a devoted body of able men, consecrated to this work, impartial, high-minded, who shall develop the facts in each case and submit the facts to Congress and the President, in whom alone rests the power of making tariffs.

We had an example in the tariff board established by President Taft. This board was so limited in its term of office and otherwise that its findings are not to be taken as conclusive as respects the need of a commission. Where, however, it was able properly to develop a schedule its findings were of tremendous value. In the cotton schedule, for instance, its findings were final and fixed the judgment of all who

studied them. There can never be again any such uncertainty as formerly obtained in this schedule which represents a domestic consumption of $500,000,000 per year. Much the same may be said of woolens, though the work there was much less thorough.

Incidentally, this tariff board was invaluable in the development of costs of production. The cost of maintaining the board was $250,000 per year. Its study of the cost of raising wool might be worth to a single state annually one or two millions of dollars were all the facts known.

It is as necessary that a tariff be reasonably low as that it be protective. Next to ours, the tariff of Germany is the highest of any great nation, and yet her tariff averages about one fifth of the Dingley rates. Her manufacturers are glad to have the tariff such as steadies their trade and conditions their success upon their extreme industry and development of progressive methods. Our nation can not afford to trifle with tariff figures. It can only afford to develop them with utmost judgment and study.

Trade Training.—As no man would enter a race with an untrained horse, so surely no nation can enter the international race for trade supremacy with untrained industrial workers. We must rival the best of European nations in the development of our working people. We must cease to draw from Europe the majority of our most skilled workers and foremen. We must share the profits and advantages of both domestic and foreign trade with our working people, not in ways that weaken the workers, for that end would only destroy itself; but in those respects which bring strength, initiative and the joy of superior accomplishment to the workers and to their employers. We must train for the occupations and through the occupations. We must link education with industry, with the day's work. We may well remember that for generations in Europe, and in several countries even now, trades are taught on Sunday as well as week days. For a trade—the day's work—rightly considered is only religion applied, and no day is too good for its right instruction. We gladly believe that our working people are the best in the world in initiative, in natural ability and energy. We are frightfully wasting all these virtues, however, by permitting substantially all of our industrial workers to leave the public and other schools by the end of the sixth grade with no connection between their meager schooling and the life they are to lead as industrial workers and citizens. We are all of us coming to see that the supreme value of education is in its application and use day by day in work and play.

There are some twenty million children in our common schools. More than half of them will get no further than the three R's when school will be foreclosed upon them forever under the present custom.

These children are receptive, imitative and obedient. They are giving nothing; receiving everything. There are some sixty millions of older people outside these schools who are the burden bearers, in whom rests every whit of the fear and the hope and the accomplishment of the present day. There must be schools for this larger number. After the European practise, we must have day schools and night schools wherein our workers will develop their varied abilities in and through their occupations and adapt themselves to the changing requirements of invention and fancy. Nothing will more vitally better our national life and nothing will more contribute to the betterment of our foreign trade relations. In some parts of the country these industrial schools have been established by force of law, and all children out of school and at work under sixteen years of age are required to attend not less than a half day a week, there to be instructed in the employment in which they are engaged or, when that employment is unfortunate, instructed in a better occupation. Similar schools are opened for the voluntary attendance of adults in the evening, and in the daytime when unemployed. The working people are taking great advantage of this new opportunity, new to us but hundreds of years old in European countries. There is no doubt but these schools will be established generally in the near future and Congress is now considering extensive federal aid and guidance for such schools.

Our Present Foreign Trade.—A study of our present exports of so-called manufactured products is illuminating. I quote from a report of the National Association of Manufacturers which I was privileged to write in 1913.

> In 1911 we exported $1,189,536,724 of manufactured products, but of this, 56 per cent., or $666,582,970, were of crude and semi-crude materials, including such food stuffs as flour, meat, cottonseed, cake, etc., $282,016,883; copper in bars, wire, etc., $104,000,000; iron and steel in bars, billets, rails, etc., $71,000,000; petroleum and other mineral oils, $92,000,000; wood in its crude forms, $72,000,000; leather, furs, and fur-skins, $45,000,000, etc. Such exports carry only from 3 to 15 per cent. of factory labor. German, French and English exports carry 40 to 80 per cent. This left exports of only $523,000,000 of more highly finished manufactures. According to the Bureau of Statistics this equaled only one sixtieth of our total product of farm and factory, and one fortieth of our manufactured products.
>
> As a people we are ignorant of foreign trade. America has been likened to a huge stevedore bearing down to the ships of the sea crude and semi-crude material for the use of the capital, labor and intelligence of foreign nations. Such exportation is a depletion of our natural resources, the heritage of the ages, and irreplaceable. Until a few years ago we were always speaking of our "limitless natural resources." We now see that under present processes those resources will be exhausted within a period that to the far-sighted is as a day. We have been proud of our agricultural exports; the scientists now tell us that every bushel of wheat exported carries with it 27c. worth of phosphorus; every bushel of corn, 13c.; every pound of cotton, 3c. These figures equal the supposed profits in the transaction. As President Wallace said at the recent Con-

servation Congress, "The Nineteenth Century farmer was no farmer at all; he was a miner, mining the fertility of the soil, and selling it for the bare cost of the mining." We sell our cotton to Switzerland at 14c. a pound, with scarce any labor in it. We buy it back in the form of fine handkerchiefs at $40 a pound, all labor. We export bar iron and import razor blades; export hides and import gloves; export copper and import art bronzes. We must acquire the skill of the foreigner to the end that our exports shall carry the maximum and not the minimum of high-class labor.

Providence has been kind to us, but Providence is likely now to leave us a little more to our own intelligence. We must henceforth sell more brains and less material. We must, to the utmost degree, develop our human efficiencies. In them is our supreme natural resource, and the only one that increases with use and will increase forever and immeasurably. Other nations, lacking our raw materials, make the cultivation of their human resources the substantial basis of their prosperity and happiness.

We are going in the right direction. The percentage of these semi-crude products in 1906 was 63 per cent. Last year it was near 50 per cent. And our great captains of industry have shown the way, for we note in passing that substantially half of our total manufactured exports are of the four items, food-stuffs, crude copper, mineral oils, and the cruder products of iron and steel. Our manufacturers of shoes, typewriters, sewing machines and agricultural implements have made as clear a demonstration of the coming development wherein American inventions and comforts may be everywhere accepted. Professor Fisher of Yale estimates the value of our human resources, the brain and spirit and muscle of our people, at two hundred billions of dollars, or five times the value of all other resources combined. What a tragedy that we have, as a nation, been careless of this resource; that we have been inconsiderate of the happiness of the average worker; of his right to highly developed self-expression and citizenship. In this the American democracy has been more careless than the monarchies of Europe. Our captains of industry find their joy of life in the development of the day's work. When 35,000,000 operatives find a similar joy derived from a developed intelligence we shall be an irresistible force in the world's betterment.

Many other things may be said, and have been, as to the development of foreign trade. We must have banks in foreign countries and a merchant marine. We must stop generalizing and be specific. We must get over our provincialism and be catholic in our sympathies. We must realize that the ocean which used to separate the countries, now binds them together. The $1.25 which carries a ton of freight one hundred miles on land, carries it a thousand miles on water. Merchandise delivered at the nearest salt-water port is almost as good as delivered at any other port in the world. The day of the brotherhood of the nations is at hand.

We may well thank Providence that not all men are as we are; that

the men of the Argentine have their own very rare qualities and appreciations; that the people of Brazil differ from all others in other splendid respects, and so of the other nations. A cosmopolitan recognition of these national differences and values is evidence of that intelligence which is the basis of trade and of all other values.

But my paper is too long. I leave other considerations to others, emphasizing only these upon which I have dwelt so long: (*a*) the widest cooperative effort with a very considerable leadership in the government and its Department of Commerce; (*b*) intensive study of each market, with samples and specifications secured under the leadership of the department supported and supplemented by the various business organizations; (*c*) the establishment of commercial museums or centers where the precise goods needed in the various markets are displayed with descriptions and lists of buyers, at which places manufacturers and distributors may assemble for study and estimates; (*d*) industrial schools and trade training that will give skill and leadership to our working people quite as much as to their employers; (*e*) an appreciation and cordial goodfellowship with those children of God who inhabit the various foreign lands, that catholic appreciation which we so greatly lack and which is a mark of intelligence and good character, which appreciation the nations we would rival have in superior measure, based upon long time proven experience.

Let us remember that other nations must live as well as ourselves. The nations that we would rival will always get their share of foreign trade and will make prices that will keep it. A man or a nation will work for half price, or less, if it can not do better. We must have entire good-will, and always will have, towards every other nation, and the measure of that good-will will be the measure of our own intelligence. In the due distribution of world trade there is and must be room for each of the warring nations equally with ourselves. We look not for temporary advantage, but rather for that superiority of accomplishment and development among our own people that will increase and hold, upon the basis of strict desert, an ever larger and larger share of the world's bounty.

The foregoing takes less account than some may wish of war's short-lived and lurid opportunities based upon temporary distress and apparent ruin. We are acting with utmost promptness and with all our strength in out-of-hand benefactions to European non-combatants and in trade extension to all non-combatant nations who are in extreme distress for want of those trade relations that we can establish for them. These things are being marvelously well done now by our leaders in legislation and commerce. They are a magnificent precursor to the stable processes of peaceful times near at hand.

FOREIGN TRADE OF THE UNITED STATES

By A. B. FARQUHAR

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THREE years ago it would have been a comparatively simple matter to address you upon the foreign trade of the United States and how best to promote it, the topic named in your secretary's courteous invitation. But a change came with the Balkan war and the resulting strained financial conditions, accumulation of public debts, private hoarding of money, and curtailing of loans in fear of a general European catastrophe. One of the prominent business men of Europe wrote me at that time that we might look for a great war, involving most of the European continent, about 1914, and he added that he was preparing for it. Well, his war has come, the most inexcusably diabolical that has cursed the world since the creation, involving the heaviest loss of life and of property. European statisticians estimate the average daily cost of it, including property and trade destroyed, from fifty to seventy millions of dollars, and the killed and wounded at from twenty to thirty thousand a day.

The nations now are so closely linked together that our hemisphere has already had to bear a portion of this heavy cost, and more yet awaits it, but our yoke will be easy and burden light compared with the crushing weight that has fallen upon Europe. Our country is on the whole happily situated compared with any of the warring nations, but when it is considered that three fourths of our exports had been taken by the nations now at war, and that they had financed most of the other fourth, it will readily be seen why our export trade is crippled, except in articles needed for war purposes.

At the outbreak of the war our indebtedness to Europe, mainly for loans to aid our railroads, amounted to over five thousand million dollars, several hundred millions of it falling due within four months. Thanks to the Federal Reserve Act and our improved currency system, which came at just the right moment, even as a godsend, to restore confidence, we were saved from the throes of a great panic. The Stock Exchange remained closed, fearing a large unloading of securities from Europe, but there never was any real danger of that. Our friends there felt that their money was safer when invested in this country than anywhere else.

That the causes of financial crises are largely psychological is almost a truism, so abundant are the proofs of it shown in every business panic; and even, as at present, without a panic. For instance, people are jubilant over the New York bank statement of over a hundred millions in excess of legal requirements on the 18 per cent. basis, when under the previous 25 per cent. basis the same reserve would be some millions

below the legal requirements, thus showing a large deficiency instead of a surplus.

The condition of Mexico is quite a factor in our foreign trade. Their imports from the United States have been much more than from any other country, coming largely of an accompaniment of our increasing investments there. We have already a thousand million dollars or more invested in Mexico. When the troubles there are over, and a government controlled by the intelligent classes and accepted by the whole people is established, we may expect a revival of trade in that section. Mexico the great Humboldt ranked as the richest portion of the world, and it must eventually become a large field for trade.

Nearly all those who know Mexico,—I have known it for many years—regarded our failure to act with most of the other nations in promptly acknowledging Huerta as a serious mistake. He was certainly far better qualified for the position of president than any of those who opposed him. He had control of 17 of the 23 states, to begin with, and with the acknowledgment of the United States could readily have established peace: we could thus have been saved all responsibility, to say nothing of our waste at Vera Cruz and on the border of ten or fifteen millions of dollars and a score of lives. We have no proof that Huerta had anything to do with murdering Madero, but, if he did, as a prominent Mexican remarked, he would be only following the custom of the country, which should not concern us.

The destruction of property is so great in Europe that we shall doubtless be called upon for large supplies, and at the close of the war a vast amount of material will be needed, which we can furnish if there is any money left to pay for it. From all this we may draw temporary profits, but, in the long run, we in common with all the world are bound to suffer from this wasteful and wicked war. We may perhaps congratulate ourselves on suffering less than any other nation. If the war continues much longer all Europe must approach bankruptcy, for its national debts before the war were already enormous. France owed over six thousand millions of dollars, Germany, five thousand millions, Russia, four thousand five hundred millions, England, three thousand five hundred millions, Austria-Hungary, two thousand millions, and Belgium, seven hundred and fifty millions. This indebtedness has already been increased by over seven thousand millions of dollars, about the estimated expense of our civil war. Our recovery after the war was rapid, only for a time interfered with by the great '73 panic, but we disbanded our armies and stopped the expense of militarism, except for pensions, which by the way for a number of years were comparatively small. If Europe will follow our example in this they may be saved from bankruptcy and recover sooner than expected, but it is probable it will not recover its former status during the life of those here present, although it is barely possible with energy and economy

and by resolute suppression of militarism, the progress towards recovery may be more satisfactory. To be sure, the Napoleonic wars and our Civil war cost their thousands of millions of dollars each, and ruin was prophesied in both cases, but the debts are almost paid. Let us hope the war will end with a genuine trial of the experiment of Christianity and an abolition of the worship of Mars and Moloch. There is nothing to be said in favor of war as a means of settling difficulties. It has never settled anything except that the strongest and most savage usually wins. The real settlement comes afterward, by arbitration, which could better be done before the war commences, with nations as with individuals. There is nothing that so easily provokes war as to prepare for it. Had Germany not been so carefully prepared, there would have been no war this year. In the old days when every one went round armed, prepared for defense, there were in consequence countless duels and homicides. No sensible man maintains that the way to preserve peace among citizens is by preparing for private wars. No sensible man can believe in war among nations, unless brought up to it, any more than he could agree with the sixteenth-century theologians that there were children in Hell not a span long.

The newspapers have made much of our great export trade in November, but the figures show that, because of the falling off in value of cotton shipments, instead of being greater it is thirty million dollars less than in November of last year. While the rest of our crops have been unusually good, with a farm value of more than three hundred million dollars over the crops of last year, the effect of the war in our cotton crop leaves a deficiency, compared with 1913, of about twenty-five million dollars for the total value of the crops. And the cotton crop is our money crop, the sale of which abroad pays a large share of our indebtedness, and in addition turns the tide of gold shipments to this country. The cotton states are suffering far more than any other portion of the country. The impossibility of selling the cotton at remunerative prices, owing to the curtailment of the foreign demand, coupled with the size of the 1914 cotton crop, estimated at over 16,000,000 bales, the largest in history, makes the financial situation there quite serious. This will not be an unmixed evil, if it urges our southern friends to more diversified farming, and cultivate economy in production and living expenses.

The success of our foreign trade depends largely upon our ability to finance it. After the outbreak of the war it was assumed by many that since three fourths of the supplies of South America, which is our most important field of exploration, came from Europe (a large portion from Germany) the war would at once greatly increase our trade there; not realizing that South America had been financed by Europe and the war made it temporarily bankrupt. We can not expect much immediate trade from South American customers unless we can give them credit,

filling the place of the European bankers. This we are now unable to do to any great extent, on account of the large amounts we owe to Europe. However, with industry and economy our indebtedness there should rapidly be reduced, when we can aid them. The branches now to be established in South America by the National City Bank of New York, under the federal reserve act will assist, by making loans and by enabling exchange to be bought and sold there (in dollars instead of pounds as at present), but it will probably be some time before our trade with South America even reaches normal proportions.

But I must not forget that I was invited to address you on our foreign trade and not on general conditions, because of my personal experience of nearly 60 years as a manufacturer, and 45 years as an exporter of implements and machinery. Some practical knowledge won from such experiences is doubtless what is here desired. To bring this strictly to date, let me recall its most recent chapter.

I visited Europe last summer—Germany, Austria-Hungary, the Balkans and Italy—went on a semi-official mission of the Southern Commercial Congress under auspices of the Secretary of State to study municipal conditions, and particular advantages were consequently given me. I found all apparently peaceful and prosperous, no thought of war or apparent preparation for war. There is a large field for the sale of our products in all that region. Hungary seemed especially prosperous.

I spent two weeks in Bulgaria, thoroughly examining conditions there. The Balkans will be a great field for our export trade when peace is declared and the Dardanelles opened. Bulgaria, Roumania and Servia are accessible by water via the Dardanelles and Bosporus, for goods may be landed direct at various ports on the Black Sea, and at reasonable rates. The country is rich and prosperous and rapidly recovering from the ravages of recent war. Bulgaria is determined to keep out of the present war if possible. I had several conferences at the palace. King Ferdinand is a botanist, much interested in conservation and the improvement of his country. Queen Elenora is a wonderful woman, understands a number of languages, is alive to all that concerns her people, was chief nurse in the army during the war, even caring for cholera patients. I went with her to their principal hospital, which is up-to-date. She arranged when I was there to have three of the nurses sent over to America to take a postgraduate course. Although Bulgarians, all spoke English. The Queen was anxious to come herself to examine American institutions and look after Bulgarians here, but the war put an end to this, as there was no way of getting over. Sofia, the capital of Bulgaria, is a handsome and prosperous city, fine buildings, streets beautifully paved. One of them, by the way, is named after Andrew Carnegie, whose benefactions seem to

extend throughout the world. There is a large field also in Roumania, which was not concerned in the late Balkan wars.

Our opportunities in Russia are practically boundless. Vodka was the greatest enemy of the Russian peasantry. It is said they will probably gain more from its prohibition than they will lose by the war. Russia will always look to us for a large portion of the merchandise formerly bought in Germany.

In conference with members of the Chamber of Commerce in Constantinople, and with government officials, I was assured that the markets there would be open to us, especially for agricultural implements and machinery. Judging from their up-to-date institutions, notably Robert College and the American College for Girls on the shores of the Bosporus (the latter largely assisted by Mrs. Shephard, formerly Miss Helen Gould, and by Mr. Rockefeller), in which the people and the government seem to take a deep interest, there would appear to be a genuine awakening; but this war will probably end with Russian control of the Dardanelles-Bosporus waterway and suzerainty over Turkey.

I also visited Asia Minor, but the land and the people ar poor and the field there is limited. Mesopotamia, once the great granary for supplies of grain and fruit, is now being irrigated, and there may be good trade there later on. It was made a desert by the forest being cut away.

There is a large opening for us in Italy, however, including machinery, improved implements and mechanical appliances generally. Although Italy is neutral, it has suffered greatly on account of the war, as has the rest of the world, with factories closed and thousands of idle men. This is made worse by Italians, to the number, it is said, of at least a hundred thousand, sent home from the warring nations. These can find no work to do, and must be supported by the government. We can not expect to do much business there until the war is over.

We have trade also with Australia. The war has temporarily paralyzed business there, but I believe it will soon revive, and the opening is exceedingly bright. The same may be said of South Africa, where we have been shipping largely for many years past. That region is rapidly improving, and we had expected a large business this year, but the civil war there and the European cataclysm put an end to it for this season.

There is no part of the world where the products of the United States may not find a market. We have only to go after it. Business with foreign countries is done very much as it is here. People are a good deal alike. We have only to furnish them what they want, as they want it, giving careful attention to packing, stenciling, and adaptation to available means of carriage. If we send men abroad they must understand the language of the country; and above all else be courteous and considerate with every one they meet. This is important in domestic

business, but essential in dealing abroad, especially with the Latin countries.

Owing to the great expense of introduction, small manufacturers will find direct trade in foreign markets impracticable. As a rule, they had better deal through our great commission houses. Their travelers represent many different varieties of merchandise, thus greatly reducing the cost of selling any special line. By the exercise of proper care in making goods, in packing and shipping as directed, risk is practically eliminated; bills being usually paid when goods are delivered on board in New York, or at least payment guaranteed. But they also may largely increase their trade by sending out a well-equipped traveler who understands the language and who will work in connection with the commission merchants in introducing their goods.

Valuable information as to export trade may always be obtained from the Department of Commerce by addressing Mr. E. E. Pratt, Chief of the Bureau of Foreign and Domestic Commerce, who is a most obliging and able official. He is appointing attachés to represent the business of this country in various leading commercial cities of the world, who will be a great aid. We can also get assistance from the Pan-American Union in Washington, the Philadelphia Commercial Museums and the National City Bank of New York. At the Philadelphia Museums samples may be found of nearly everything wanted abroad.

In short, to earn success in foreign trade it is only necessary to follow the examples of European nations that have made a success, and to persuade our politicians to cease from hampering us. As an indication of the value of this foreign trade I may say that our exports of manufactures abroad amounted in 1913 to one billion five hundred million dollars, and the total exports to two billion four hundred sixty millions. Our exports to Latin America were two hundred and fifteen million dollars. We furnish two thirds of the cotton raised in the world, yet South America imports from us but about 2 per cent. of her supply. We are far away the largest steel-manufacturing country in the world. South America buys about 20 per cent. In fact, but about 15 per cent. of her purchased manufactures, all of which might be made in this country, are bought of us. The major portion of this came from the warring nations. It is especially this trade we must look after and prepare ourselves to obtain.

May I suggest in passing that we should prepare for hard times by restoring the simple life of our fathers? Waste less. Three cents a day saved by every inhabitant of this country would amount to more than the thousand million dollars a year that it takes to support the national government. Less than ten cents a day per capita would pay the total expenditures of governments, federal, state, municipal, dispense with further taxation and greatly lessen the cost of living. Astonishment is

often expressed that France is able not only to finance its heavy public expenditures, but loan hundreds of millions of dollars abroad. This is explained by the economy of the people there, who save the three cents a day that we waste.

When discussing commerce it is necessary to speak at length of war, as it is the greatest enemy of trade. The dark cloud of war still rests over us, with no sign of breaking or lifting. Many of our factories are closed or working short time, and there are hundreds of thousands out of employment. Our goods are needed abroad, especially in Latin America, to take the place of those formerly supplied by the warring nations; we need their orders to start up our wheels of industry, and some means must be found to secure them. Export markets are necessary to economical manufacture, as they lower the unit cost of production, as our total domestic trade will only keep our factories running about two thirds full and the profit largely rests on the remaining third. Export work, therefore, can be done cheaper than domestic trade. Although we have the advantage in raw material and can compensate for higher wages by increased efficiency, we have had to compete with nations that have made foreign trade a study, who have a better merchant marine than we can ever have under present restrictions. We must compete with nations that encourage business, the bigger the better if lawfully conducted, instead of persecuting them as though success was criminal rather than a proof of merit. The political opposition to those who succeed through ability must die out before we can hope to permanently hold the lion's share of export business.

FOREIGN TRADE OF THE UNITED STATES

By DUDLEY BARTLETT

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THE old maxim "in time of peace prepare for war" has a new meaning and a new application. The situation created by the European conflict has emphasized the necessity for preparedness to meet emergencies which may arise, affecting the commercial requirements and financial conditions of countries whose trade we seek.

Many a country whose usual sources of supply have been cut off and in which we might find a new market for the products of our factories, is *terra incognita* to a large number of our manufacturers, and valuable time is being lost and false moves will be made because of the altogether too nearly universal ignorance of the conditions, needs and business methods of important commercial centers abroad. And there is really no excuse for such ignorance.

Twenty years ago a manufacturer had few aids to the acquirement of such knowledge. Information regarding the local demands, the

present supply, the names and reputation of possible customers and similar data necessary to conduct business intelligently and safely could be obtained only by personal investigation and experience. To-day he has at his disposal means of securing the fullest details at a cost so small as to be insignificant.

Through departments of the United States government, institutions like the Pan-American Union, and through such bureaus of information as that conducted by the Philadelphia Commercial Museum, he can obtain the most detailed information regarding any market in the world. Information on such subjects as shipping, invoicing, packing, banking and customary terms of sale is readily obtainable, while efficient and responsible translation bureaus provide our manufacturers with means of communicating with merchants and importers in all parts of the world in their own language.

We hear much of the aid given to German exporters by their government, and comparisons are frequently made, unfavorable to similar efforts on the part of our own government. It is nevertheless a fact that in many ways the United States is doing more to assist our manufacturers than is done by any other country in the world, Germany not excepted. There even is danger that American manufacturers may expect too much from the departments at Washington engaged in this work. It is one thing to ask such departments to investigate, report and advise, it is another to expect them to place orders in our manufacturer's hands.

The Agricultural Department conducts investigations, reports results to the farmers of the country, and gives them much valuable advice. It does not and can not till the soil, plant the seed, and reap the harvest for each farmer, although there seem to be many who expect the government to do all this for our manufacturers in the cultivation of export trade. The government can do much preliminary work, institutions like the Commercial Museum can lend valuable aid, there are export commission houses which can handle the shipping and financing of orders, but if a manufacturer is to secure a lasting hold on foreign markets he must do the *selling* himself. The assistance which is offered to the manufacturer to-day is in some respects like that which a physician gives to his patient. He may prescribe the remedy, but it is useless for the patient to expect satisfactory results unless he does his own part by following the accompanying instructions as to diet and exercise.

There is a vast difference between the world to-day and the world 50 years ago. Distances have been shortened—almost eliminated—and what were but a brief lifetime ago separate groups of human beings, in a large measure independent of each other, now form one great body—dovetailed and interwoven so closely that any serious shock to one of the component parts is distinctly and immediately felt by all.

For a time at least the whole commercial mechanism of the world is thrown out of gear by the European war. Important parts have been crippled, and it will be some time before the rest of the machinery can adequately perform its usual functions. The situation thus created has been called a very paradise for the pessimist. But there are those to whom the ill wind may blow some good. Opportunities have been created for the marketing of the products of our factories and farms which did not formerly exist.

Germany's great export trade of some two thousand millions of dollars is practically killed, for the time being, exports from the other countries engaged in the war have been cut off entirely or materially diminished, and many orders from neutral countries, heretofore sent to Europe, will doubtless come to the United States. It is the time for prompt but not for precipitate action on the part of our manufacturers. It may not be surprising, however, if some of them neglect to look over the fence to see what fruit may be ready for the plucking in the adjoining field, for there is that little item of nearly two hundred million dollars worth of goods which Germany has been sending to the United States which is worthy of some consideration, and in certain lines the best opportunities created by the war are right at our own doors.

It is the new markets in other countries, however, which we are considering at this time. South America seems to appeal most strongly to a majority of those studying the question, and there are good reasons for this. It is not because of proximity; we are practically no nearer the leading markets of South America than the great European manufacturing nations. It is not because of any sentimental reason arising from the fact that we are on the same side of the globe, any more than the fact that we are on opposite sides of the equator should act as a deterrent factor in our trade relations. It is certainly not due to any blood relationship; some European nations are much closer of kin to the people of South America than we. It is mainly due to the non-existence of trade competition. Neither in the home market nor abroad do we enter into competition in any considerable degree. When competition does enter, it is in natural and not manufactured products. It is, nevertheless, a fact that the greater markets for our manufactured products are found at present in countries which are our keenest competitors.

But there are other markets than those of South America, markets which are sometimes called neutral because in them we meet the other manufacturing nations on a plane of equality not assisted nor hampered by discriminating customs tariffs nor other governmental aid or impediments to trade. Some of these markets are growing rapidly in importance, and their future prospects are quite as bright as those of South America. The far and near east present alluring opportunities for the future if not for the immediate present. The English colonies,

although giving preference, in the matter of customs duties, to English products, are large, growing, and in many respects safer than the Latin-American fields of endeavor.

There is, however, a great economic problem which may be solved to the advantage of this country by prompt but conservative action in connection with the development of our trade with South America. It is possible that this country may replace England and Germany in the growth of South America to an extent greater than is possible in other parts of the world, but this can only be accomplished if the United States takes a greater financial interest in the development of South America's resources. In other words, we must become larger creditors of the countries to the south of us if we hope to retain the trade which may be temporarily forced into our hands under the stress of unusual circumstances arising from the present European conflict.

The total trade of the twenty Latin-American Republics amounts to about three thousand million dollars, approximately one half of which consists of exports and one half of imports, under normal conditions, the exports exceeding imports by about two hundred million. We already predominate in the combined trade of ten of these republics. In the trade of the ten countries in South America we stand third, ranking very close to Germany in exports to, and second to England in imports from them. We buy from them fourteen million dollars' worth more than Germany buys. Our purchases from these countries exceeds Germany's sales by sixty million and our own sales by about ninety million. Great Britain's sales top ours by 120 million, exceeding her own purchases by twenty-seven million. We are the only one of the three nations which buys from them more than we sell. Our large purchases of rubber and coffee from Brazil are mainly responsible for this condition.

It is with no desire to belittle the importance of this trade that I express the fear that we may be overshadowing the possibilities of other markets through disproportionate attention paid to those of South America. For immediate results and greater certainty of securing payment for what we sell, I believe that some of the European countries, including Great Britain, who has been a purchaser of German goods to the amount of some 350 million dollars annually, and the British Colonies, offer greater immediate inducements and better possibilities of increasing our trade along lines of the least resistance.

Australia, for instance, buys from Germany about thirty-five million dollars' worth each year. These and other markets are too important to be lost sight of through over attention to those of South America. At least there is no valid reason why we should reject a good fat trout or two because we are fishing for eels.

I want to say a few words regarding the use of official statistics in estimating foreign trade possibilities and prospects. Before we had re-

covered from the first shock of the news of the European war, a number of ingenious newspaper writers and some men, whose reputation for knowledge of foreign trade conditions is rather widespread, figured out a golden harvest for our manufacturers and exporters.

Their predictions of great and immediate profits were based on statistics of the trade of the contending countries with the rest of the world—a trade which they prophesied would necessarily fall into our laps. They arrived at their conclusions in this manner:

> The exports of Germany, Austria-Hungary and Belgium amount to three thousand million dollars.
>
> This is totally cut off.
>
> The exports of France, United Kingdom and Russia total five thousand million dollars.
>
> This will be reduced by say two thousand million dollars.
>
> Add this two thousand million to the lost trade of the other belligerents and we have five thousand million dollars—which represents our opportunity.

If we succeed in securing only one half of this we shall double our export trade in one year. Side issues were lost sight of. The fact that of Europe's export trade of some twelve thousand million dollars, two thirds or eight thousand million represent sales of European countries to each other, was ignored altogether. In this connection, the circumstance that 80 per cent. of Belgium's exports were to European countries and 75 per cent. of the exports from Germany went to her immediate neighbors in Europe is of interest. England alone sold and still sells the bulk of her products to countries outside the continent, only 35 per cent. of her exports being shipped to that part of the world. The decreased purchasing power arising from the loss of their most valuable markets by other countries and the withdrawal of European capital, which financed a vast majority of the industries and public enterprises of many countries, was not considered.

"Figures can not lie" is an old adage, but they can be made to perform most amazing contortions. Let us consider for a moment the application of statistics to the study of a single commodity. Robinson & Company—for instance—makers of picks and shovels, discover that the Argentine imports, annually, $500,000 of these necessary implements, and that Germany has divided the trade in this line with England, each sending about $250,000 worth a year. Because of the war, Germany is eliminated—consequently Robinson & Company have but to slip in with their goods and fill the vacuum caused by Germany's forced withdrawal.

That is the situation as it appears after a careful study of the official statistics, but when their representative arrives in Buenos Aires he finds, to his surprise, that while it is true that 500,000 minus 250,000 equals 250,000, is it equally true that 250,000 minus 250,000 equals zero. (That last 250,000 represents the diminished purchasing power and decreased demand arising from the same cause which brought about

the elimination of German competition.) Moreover, he discovers that practically the entire local trade in picks and shovels has been in the hands of two firms, one representing a German manufacturer, the other representing a British manufacturer. The German firm is out of business, but the English house is on the ground and prepared to supply the limited extra demands made on it through the failure of its German rival. Robinson's representative learns, therefore, what many of our manufacturers are learning, that while the time is ripe for a general campaign of education and promotion, the prospects of securing large immediate results are more remote.

I sometimes wonder whether we are not apt to give too great prominence to so-called international competition and to forget the more active and practical competition of the individual. Is it not, after all, Peter Smith & Company of Liverpool, and the Actiengesellschaft Hans Fleischmann, of Hamburg, that Robinson & Company must consider, with all due references to the possible competition of Jones & Company, whose factory is perhaps just across the street.

"How can I sell in competition with English and German manufacturers when they pay no more for their raw material and less for labor than I do?" said a hosiery manufacturer to me recently. "I give it up," was my reply, "but a manufacturer in your line, whose factory is not two miles from yours, is doing so." And when I produced the proof, his only reply was essentially that of the countryman who saw a giraffe for the first time—"They ain't no such animal."

Competition is largely a personal matter, and he who wins is not necessarily the one whose goods are the cheapest. Salesmanship, honesty, liberality, courtesy, fair treatment, persistency, compliance with specifications as to packing and shipping, which may at first glance seem trivial and unnecessary, but are often most important, are all great factors, not only in winning trade in foreign markets, but also in keeping it when once won.

AMERICAN MUNICIPAL PROBLEMS AND THE EUROPEAN WAR

By CLINTON ROGERS WOODRUFF

NATIONAL MUNICIPAL LEAGUE, PHILADELPHIA, PA.

THERE was great uncertainty in August and September of the year 1914 as to the immediate and ultimate effect of the European cataclysm. No one was willing to hazard a guess as to what was going to be the outcome of those events following the outbreak of the war, which unsettled at least for the time the whole machinery of international life. There was a prevalent conviction that the old foundations had been swept away, and there was no assurance as to what were

to take their place. The feeling extended to every sphere of life, and notably to municipal affairs. Attention was everywhere directed to the war, its progress and probable results. In the words of one commentator on the situation:

> Already now civilization stops—stops dead. Religion, philosophy, literature, painting, and, chief of all perhaps, science, with its torch at the head of our human hosts, are suddenly flung backward; they become of no moment. Who wants to know about Immanence? Who cares to hear what Bergson and Eucken think? Who bothers about books and pictures? Who is ready to endow a laboratory or listen to the chemist and the biologist?

And who, a Unitarian clergyman (John Haynes Holmes) asks, in quoting the above, "cares a fig about the social movements"?

Jane Addams, usually so calm and sane, declared

> that all is out of joint, out of character. Human sensibilities were more acute when this war began than ever before. The comradeship, the friendliness between nations had been brought upon a basis of mutual understanding further than ever before. By mechanical means we had been brought closer together in communication and in sympathy. Either we ought not to have equipped ourselves with these fine sensibilities, or we ought not to have to face the horrors now confronting us. It is a too terrible inconsistency against which we should protest. All organized social welfare activities are put back for years. We have to work up public opinion anew.
>
> When a million men are suffering in trenches wet and cold and wounded, what are a few children suffering under hard conditions in the factories? Take old-age pensions, upon which England, France and Germany have been working. With widows and fatherless children numbered by the thousands in each of these countries, what are a few old people more or less? It will be years before these things are taken up again. The whole social fabric is tortured and twisted.
>
> Infant mortality is one of the things which we are just beginning to deal with.
>
> But what are half a million new-born children in comparison with such a slaughter—the hideous, wholesale slaughter of thousands of men a day?

Social and civic workers in large numbers shared this lament and the feeling and conviction back of it. It really did seem in those first days as if all that had been gained through years of toil and painful effort had been lost; that the foundations, as well as the superstructure, of modern society, which is so largely urban in its character, had been undermined—but first a few, and then many more students began to ask questions, and make inquiries. What effect is the European war having and likely to have upon the municipal situation, and especially in this country? Has it diverted interest? And if so, in what way? Has it interfered with the orderly functioning of the city? Has it stopped public improvements? Has it hurt municipal credit, and the development of sound municipal sentiment? Has the war diverted interest in city affairs?

From a Los Angeles editor (and I may say in passing that the great bulk of the testimony I shall offer will be from well-known editors of

long experience as trained observers of public opinion in their respective localities) comes this message:

> We have been unable to note any effect upon municipal activities in Los Angeles because of the European war. I do not anticipate any material diversion from municipal affairs nor does there seem to be any indication that the war will hurt public improvements, unless it be for those projects which depend upon the sale of bonds.

Pasadena, Cal., reports:

> So far as we have been able to learn, the European war is not affecting municipal conditions in Pasadena. The development work of the city has not been retarded. To the contrary, several large projects are under consideration. It is expected that these will be carried to completion within the next few months.

From Santa Ana, a small California city of 12,000 people in the midst of a purely agricultural section of country, remote from the great industrial centers and with very little connection or relation with them, we hear this testimony:

> We have no large municipal or private enterprises under way and so far as I can see the European war is not affecting municipal conditions here at all. However, judging from a general survey of public sentiment and expression, I should think that if, for instance, we undertook to vote bonds in any considerable amount for public improvements, it would be more difficult to carry them, than if a state of war did not exist; likewise I think if any large private enterprise were undertaken that sought subscription to its stock and purchasers for its bonds among the people at large, more difficulty would be encountered now than before the war broke out.

In San Francisco at first there was

> a very pronounced diverting of interest and attention among the citizens, and business of all kinds suffered; the Exchange was for a time daily thronged with business men, but that soon became the usual old story and the normal attention to other duties was resumed.

Another editor in the same city writes that:

> There is at present a good deal of municipal improvement work under way in this city, the funds for which are provided by the sale of bonds. These were authorized some time ago, and thus far there has been no impediment to carrying out the original plan, although there is a prospect in the near future that it may be difficult for the city to sell its bonds at the rate of interest which they bear. Up to this date, however, we have not put a stop to anything on account of the depression due to the war, which has extended itself to this city, as to other parts of the country.

A Portland, Oregon, editor writes:

> that the people of Portland, like those in all other cities, are giving a good deal of attention to the stories that appear in the papers about the war. But I do not see that the war is retarding development. Development is retarded just now by hard times and the consequent fear that investment in new enterprises will not be safe.

Another declares:

> The chief effect of the conflict appears to have been the depressing effect upon the sale of city bonds. Eighty per cent. of the street improvements in

Portland are financed by bonds. The prices the city can get for them have dropped. This is the price received for the 6-per-cent. ten-year bonds. Long-time bonds, which are used to raise revenue for building public docks, constructing additions to the water system and other purposes, have no present market. No bids were received on a recent issue of $150,000, 25-year 4-per-cent. dock bonds. Ordinarily these bonds sell about 90 per cent. Whether or not the war is retarding the development interest of citizens by diverting attention can only be guessed. Retrenchment in municipal improvements of this kind has been noted, however, for a year or more past. It has been more pronounced since the war, but whether it is the outcome of the war or due to local or national financial conditions, or conditions purely local to the improvement districts affected, can not at this time be definitely ascertained. Apparently the war has no effect on partisan affiliations of citizens.

Seattle reports that the Eurpoean war "has not appreciably affected municipal conditions in Seattle, unless perhaps it may be in bringing more sober attention to matters of taxation and the like," certainly a most desirable result, and right here it may be pertinent to remark that increasing federal and state expenses are destined to have the same effect.

So far as the Pacific coast is concerned there is practically but one story. The same is true of the central sections. The report from Duluth, Minn., reads:

Apparently the war has had no effect here on municipal conditions. Street work and other improvements are going ahead as if nothing had happened, and the city is now having a very warm debate on the question of purchasing the electric lighting plant or building a new one.

That from South Bend, Indiana, is to the same effect:

The European war has produced little or no effect upon municipal conditions in South Bend. I do not believe it will interfere with any public improvements;

and Louisville, Ky., likewise:

We can note no effect whatever of the war conditions in Louisville.

A well-known editor of Kansas (William Allen White of *The Emporia Gazette,*

can not see that the European war is having any effect on the small cities of the West.

Another declares that

the war is making little difference with politics in Minneapolis. We have the non-partisan city ballot and war and social issues are kept out of the campaigns.

The northwest generally, being near the wheat-fields, is not much affected by the war at present.

A Chicago editor in September felt that the war was likely most seriously to divert attention from local politics, and declared that the primary elections showed a distinct falling off, due to the absorption of interest in the war. The November elections, however, do not seem to have been any less hotly contested and their results can hardly be

said to have reflected any war influence. In most places, the decisions reached were about the same as were anticipated before the war broke out.

From a Lexington, Ky., publicist comes the observation that

it would be difficult to say that the developing interest of our citizens is being retarded by reason of attention diverted on account of the war situation. The retardation certainly exists, but appears to be caused indirectly by money stringency and uncertainty of market conditions. This is especially true in regard to the tobacco market, activity in which is to a certain extent dependent upon the interests of foreign purchasers. The very extensive tobacco crop of this section is not marketed until December 1 and thereafter, but uneasiness as to the conditions when the market does open is having a quieting effect upon all local development as well as business activity. There is a very small foreign population here, and partisan affiliations are not worthy of consideration. This city is not at present undertaking any extensive new public improvements and there is no present demand for improvements which would require bond issues or similar obligations.

This letter brings up a question that has no doubt occurred in connection with the other testimony so far adduced. To what extent is the difficulty of marketing bonds and therefore of undertaking improvements, and to what extent is the demand for retrenchment and greater economy of administration, to be attributed to the war; and to what extent to the financial stringency and hard times that existed before the war? That the war has accentuated the difficulties of the situation rather than caused them is the opinion of many students of the drift of municipal conditions and opinion.

New England's testimony is remarkably like that which comes from the Pacific coast and the central west. Only in the south does the war seem to have been directly responsible for a greater stringency—and that has been due to the fact that it has in the past so largely depended upon a few crops, mainly cotton and tobacco, rather than upon diversified industries.

I do not observe that the European war is retarding or developing the interest of citizens in our community,

writes a Portland, Maine, editor,

nor that it has had any material effect on their partisan affiliations. I should think it might hold up public improvement to some extent since, for the first time in the history of the city, so far as I am aware, Portland has found it necessary to sell its bonds at less than par, the figure received being $95.28. Otherwise there seems to have been no visible effect upon the city;

and Springfield, Mass., reports that

it does not appear that the European war is detracting from the interest of citizens in local improvements. It is, however, making our people conservative in undertaking new public enterprises. It looks now as if various proposed improvements might be temporarily postponed.

In New Haven, Conn.,

municipal conditions are not affected; and, if affected at all, they are improved

slightly instead of being the other way around. Public improvements also are not affected by the war agitation.

And the same is said in Hartford, where there is no evidence that the foreign situation has diverted attention from public welfare.

In the Middle Atlantic states the same general situation may be said to prevail. Let me quote from just two letters: one from Harrisburg, Pa., and one from Wilmington, Del. From the former we learn that, so far as careful observation goes, while the war is undoubtedly attracting considerable attention,

it is not materially distracting the attention of our citizens from the business they have in hand. Whether it will cause the holding up of public improvements can hardly be determined before next spring, the time for starting new work in this direction, and I should think would depend upon intervening war developments and the conditions of the money market at that time.

A Wilmington editor

can not see any indications that the war in Europe is retarding the development of interest in municipal conditions to any appreciable extent. Certainly it is attracting interest in an extraordinary manner. At the primaries thus far held there has been about the average expression of popular interest in the size of the vote and the selection of candidates. I do not believe, therefore, it will have any detrimental effect upon the election by blinding the attention of interested citizens to the need of careful voting. Indeed, there has been a notable instance to this effect in the repudiation, by a county caucus of the Republican state convention, of a brawling ring politician who sought preferment by getting a place on the state committee.

There is not any probability of the war influence affecting public improvements adversely. Work on our greatest improvement—the joint city and county building—is progressing finely. Private building operations are going on as usual.

These views selected from a great mass of correspondence are typical, and unquestionably reflect the fact that the American municipal citizen, while profoundly interested in every phase of the greatest of modern wars, nevertheless is going about his municipal business just about the same as usual, but with somewhat more care and thoughtfulness than formerly, and, perhaps, with a greater concern about beginning improvements, and about their execution, when once determined upon.

Generally speaking, the influence by and large of the European war on these phases of American municipal life has been much less than had been reasonably anticipated.

Nor has the war interfered with the orderly functioning of the cities. While there has been a natural conservation in the undertaking of new work and the assumption of new functions, so far as reported, there has been no abandonment of those lines of activities previously assumed, and regularly carried on. It must be pointed out, however, that if it had not been for the war, the new year would have seen the greatest development of municipal activity the country has ever wit-

nessed, along both physical and general lines, and I am not at all sure that the war will check the latter. That it has seriously interfered with the former, however, there can be no doubt. This condition is partly due to the unsettled financial condition of the country, and would have prevailed even had there been no war. Municipal credit, as such, however, does not seem to have been seriously hurt, or jeopardized.

There has been a natural disclination of capitalists to invest in municipal, or, for that matter, in any other issues, although this timidity and unwillingness is beginning to show signs of disappearing with the opening of the stock exchanges and the reestablishment of the financial machinery. This hesitancy to take municipal issues in large blocks has accelerated the tendency to market municipal bonds in a new and more democratic way, namely, in small denominations, over the counters of the city treasurer. In this way municipal undertakings will be brought more directly home to the attention of the voters and their interest in the construction and up-keep thereby stimulated. In addition municipal finances will be placed upon a more substantial basis in that cities will consider more carefully their expenditures for permanent capital account and for maintenance, and will eventually cease to borrow on the future for the expenses of to-day. Here again, however, the war has helped on a movement already well started. There seems to be a great difference of opinion among social workers as to the effect of the war on social problems. Miss Addams's opinion has already been quoted. On the other hand, however, we have the opinion of another Chicagoan, who speaks out of a long experience, and a profound sympathy with every forward social movement. Dr. Graham Taylor declares as a result of his personal observations:

> That first week in August, which threatened Europe with the greatest destruction which has ever overtaken its civilization, was signalized by the most constructive, or reconstructive, legislation ever enacted in any one week throughout the long history of the British Parliament. And it did so in the rush of its gigantic defensive and offensive preparations for war. Although all these measures are temporary provisions to meet the emergency demanding immediate relief from the present or possible disasters of war, yet they can not fail to affect profoundly the social legislation and administration which had already become the permanent policy of the British empire and of its county and municipal governments.

So far as my personal observation has gone, there has been no substantial falling off of interest in American constructive programs, and in many directions there has been an increased effort to offset any possible slackening of interest. The obvious reply to Miss Addams's lament (and we all deeply sympathize with the feeling which gives rise to it) is that the very greatness of the European cataclysm will emphasize the need for even greater social and civic effort. In the words of a Milwaukee student of the problem:

Those men and women who are engaged in municipal and social reform have the keenest realization of the terrible price to be paid by this war. And when it is all over and the awful price has been paid, they are going to demand that social reform instead of militarism shall have the right of way.

The significance of the present situation is that social and civic workers have redoubled their efforts, in the face of the natural depression incident to the war, and have shown no slightest evidence of intention to abandon any advantage secured, or position occupied. In addition they are looking further ahead than usual. There is an increasing conviction that social and civic problems of great magnitude will follow in the footsteps of the war. The commissioner-general of immigration holds the opinion that the natural thing to expect after peace is declared again is a quickened flow of immigrants to the United States. If the war is serious and causes general business depression in the countries which it affects, increased numbers of the working classes will have to seek opportunities in this country.

The normal flow of immigrants to this country, according to *The Survey,* has been about 90,000 a month. Those who have already planned to come, but have been held back by the war, the commissioner-general expects to sail as soon as they can get accommodations after peace is declared. Moreover, many of the foreign men who may leave this country to take part in the war, if they can obtain passage, he expects to return later to resume their work here. Adding together those whose trips have been postponed, those who have left the United States temporarily, and the normal yearly number would send immigration records up to a new high mark. This is but one of many situations our cities will have to face—for all our civic and social difficulties find their greatest manifestation in the cities; and the students and workers foreseeing this are preparing for it.

One effect of the war will be to compel Americans more largely than heretofore to solve their own problems. We have so freely availed ourselves of European experience that we have in some directions lost our initiative. European precedent has been dominating. Now we are thrown back on our own resources, and this in the long run will be a great gain, for we can not hope invariably to solve American problems solely by European methods. In fact, progress has sometimes been held back because of our underlying antipathy to the foreign label. We have studied other situations sufficiently long and carefully, to know the best they have to offer in the way of suggestion. Now we shall have an opportunity of showing what we can do when compelled to depend upon our own resources.

To sum up: The European war seems to have had far less influence upon our municipal life than was at first anticipated. It has not diverted, except temporarily, public interest in local affairs. Although the war has occupied an undue amount of space in the newspapers and

magazines, this lack of perspective on their part does not seem to have affected that of their readers. The finances of our cities have been strengthened and accelerated. There has been no slackening or diversion of interest or effort on the part of social and civic workers. On the contrary, they have manifested a determination and persistence of the greatest significance and there has been a throwing back on our own resources that will develop a self-reliance and an American policy of social welfare and municipal administration that will constitute a worthy contribution to the advance of mankind.

THE FREE PORT. AN AGENCY FOR THE DEVELOPMENT OF AMERICAN COMMERCE

By Dr. FREDERIC C. HOWE

COMMISSIONER OF IMMIGRATION AT THE PORT OF NEW YORK

IN the discussion of conditions necessary to the rehabilitation of the American merchant marine and the promotion of American over-seas commerce, one very important factor has been neglected; and that is the necessity of cargoes, not only for incoming ships, but for outgoing ones as well. This is absolutely essential to a profitable merchant marine service. It can only come into existence upon a commercial basis.

Present economic conditions provide outgoing cargoes of raw materials, food stuffs and certain manufactured products. This comprises the bulk of our export trade. For the most part it is directly consigned to the ultimate buyer. There is but little direct over-seas trade to South America, to Africa, to the Orient, for these countries desire mixed rather than simple cargoes. We buy largely from these countries, but our purchases come to us through European ports. This increases transportation costs, and supports foreign ship-owners. These conditions spring partly from our high protective tariff, partly from the fact that America has few foreign banking connections, and partly from the general nature of our industry.

I believe that our merchant marine would come to life again if it were possible to speedily and surely find outgoing cargoes from American ports. This is a *sine qua non* to the establishment of direct routes with other parts of the world. The modification of the registration laws will not solve this problem, for this will not furnish cargoes. That can only be achieved through the creation of conditions under which the wealth of the world will come to America for sorting, re-assembling and re-shipment, as is now the case in Great Britain, Germany, and in some of the ports of the continent as well.

The carrying trade of the world is now performed by those countries that have substantially free trade. They are England, the free ports

of Germany, Belgium, Holland and Denmark. The bulk of the carrying trade is done by Great Britain and the German ports on the North Sea. Great Britain is substantially a free trade country. It is this fact that makes her the clearing-house of the world. Goods are brought to her ports from America, the continent of Europe, from Asia, the Indies, Africa, South America, and the islands of the seas, where they are re-assembled for distribution again to the places of ultimate purchase. For fifty years England has been mistress of the seas for the very simple reason that ships could come to her ports without the payment of customs taxes; they could there discharge their cargoes and find other cargoes awaiting them without delay. There were no obstacles, obstructions or tariff barriers of any kind to interfere with traffic. It is this that has built up Great Britain during the last fifty years. Her ports were counters, market-places, clearing houses for the making of a million transactions and the distribution of the most diversified products of every clime.

It is a recognized fact that water transportation will go hundreds of miles to escape tariff barriers. The protective tariff killed the Spanish trade; it destroyed the rich and prosperous cities of the Netherlands. The abolition of the Corn Laws by England opened up her ports when the ports of all the rest of the world were closed, and brought to her shores the carrying trade which had previously been distributed among many nations.

The free cities of Germany, Hamburg, Bremen and Luebeck, had enjoyed free trade for generations. Their wealth and power sprang from their over-seas commerce. And when they entered the German Empire, provision was made for the partial retention of these conditions by the building of free ports within the harbor. Copenhagen and Hong Kong have done substantially the same thing, while Antwerp —another great shipping point—enjoys substantially free trade.

And America can not hope to compete with these free-trade countries, she can not hope to be a clearing-house, or to have ready at hand cargoes for outgoing ships until natural conditions enable this country to compete with Great Britain and the continental ports which have substantially free trade. And these conditions can be secured without modification of our tariff laws by the extension of the warehousing system which now prevails, and the establishment of a series of free ports similar to those in Germany. I would suggest that congress provide three such ports upon the Atlantic sea-board; one on the Gulf of Mexico; one on the Panama Canal; and one or two upon the Pacific coast. These ports might be opened in cooperation with various cities which would agree to build and equip the harbors so that the clearance of goods would be facilitated; or the government itself might provide such ports, to be maintained by low harbor charges. Cooperation with the cities would stimulate them to acquire their own docks and harbors,

which for the most part are under the control of private interests. Into these free ports of entry ships could come from all over the world, just as they now go to Liverpool, London, Bristol and Hull. Here their cargoes could be placed in warehouses not dissimilar from our present bonded warehouses, without the payment of customs duties. Here they might remain for an indefinite period. In other cases ships could break their cargoes, transship a portion of them to another vessel, or add to their existing cargoes before they continued their voyage. Or a cargo could be discharged and another assembled cargo from various parts of the world could be loaded for some other destination. The free port would become not unlike the Bush Terminal, New York, not unlike the ordinary railroad freight station in which miscellaneous consignments of goods are collected preliminary to shipment to their destination in bulk.

A short description of the free port of Hamburg indicates the operation of this system. The free port consists of a large number of basins, many of them cut into the land, with quays jutting out into the river. Upon these quays are railroad tracks with cranes for the easy transfer of freight into the near-by sheds. In the larger outside basins are many mooring posts which provide anchorage for vessels transshipping cargoes in the stream. A number of warehouses are operated by the port authorities as a part of the free port. Goods are stored in these warehouses for re-export or for ultimate consignment into Germany or other countries of Europe.

The free port is considered by the customs department as foreign territory. It is surrounded by a customs line, guarded by customs officials. The line is designated by high iron palings along the land side; and along the river is a floating palisade guarded at either end by customs officials. At the land and water entrances of the free port are customs booths at which duty is paid on goods when they enter the harbor.

All of the harbor pilots are *ex officio* customs inspectors. Under their guidance ships pass to their berths in the free port unmolested by customs officials. There are no declarations of dutiable goods to be made; no customs officials are taken aboard with the delays attendant upon their presence. When a ship is cargoed ready for sea, a customs pilot takes her to the mouth of the river. There is less hindrance to the free movement of the ship within the free port than in England.

The free port contains a number of industries incident to the care and feeding of employees, shipyards for repairs, and other industries relating to the outfitting and provisioning of ships. Big river barges of from 600 to 800 tons capacity move from ship to ship for the transshipment of freight.

The free port is in the hands of public authorities, although it is partially privately operated by the warehousing company which has erected warehouses upon public lands.

A number of means have been devised to facilitate the care and handling of goods. Goods to be imported pay duty on the spot; or the importer may have a running account against a deposit made by him in the form of government bonds. Provision is also made so that goods may be shipped with a customs certificate to the inland consignee, who pays the duty on delivery. Similar procedure is provided for goods forwarded in transit through Germany to other countries.

By reason of the free port, as well as the industrial development of Germany, Hamburg has become the second seaport in the world. It does more business than London, or Liverpool, and is a close second to New York. The total foreign commerce of the port is just short of $2,000,000,000. It exceeds that of London by $100,000,000 and far exceeds Liverpool in imports.

Students of the commercial ascendency of Germany are in substantial harmony as to the great value of the free port as an agency in the country's development. Mr. Edwin J. Clapp in his treatise on the Free Port of Hamburg says:

> The first advantage of the free port is in facilitating re-exportation; indeed the importance of the re-exportation trade is large and, above all else, led to its creation. In the free port foreign merchants can maintain sample or consignment stocks. Bonded warehouses do not offer the same opportunity for unhindered movement of merchandise within a port. Everything must be done under the control of customs men. In Hamburg there is no need of counting and verifying pieces when a re-exportation is made. A bonded warehouse can not offer the same facilities for various manipulations necessary to prepare the goods for the consumer, such as cutting wines and mixing coffees.
>
> Perhaps, the chief advantage of the free port lies in the facilities it offers for the rapid frictionless discharge of ships with dutiable goods, whether destined for re-exportation or shipment inland.
>
> The free port of Hamburg lets the Hamburg merchants store their goods duty free, and offers them complete freedom of manipulation for re-exporting them or for sending them inland, as the market dictates.

Many other advantages in addition to the re-establishment of American shipping and an American merchant marine will follow from the opening of free ports. Among these advantages are the following:

1. It will link the United States with South America, Asia and Africa by trade connections which will tend to the promotion of friendly relations to the commercial advantage of each and will supply an easier outlet for American goods, which now have to go in bulk to England or Germany for transshipment to other countries, or do not find an outlet at all.

2. A second gain lies in the bringing of great quantities of goods to our shores for importation or export, as trade needs demand. To these ports American manufacturers or buyers in need of foreign supplies can go and secure them at American ports rather than in foreign countries. In these ports merchants can exhibit samples; they can mix, grade and alter commodities for domestic or export use; and can

otherwise meet the trade conditions of different countries. Growing out of this will be a stimulus to exporting business. Firms can hold goods for an indefinite period without the payment of customs taxes, often equal to the cost of the article itself.

3. Such ports will upbuild our banking and financial relations with other countries. It will shift to America an increasing share of international exchange. It will make America what, by reason of its size and natural resources it should be, the clearing-house as well as the financial reservoir of the world.

This is an opportune time for the development of the free port, even though only one or two experiments are made. A large part of the shipping of the world has been driven from the seas. English, German and Belgian bottoms are in danger of capture. Old trade routes and commercial connections have been destroyed.

In addition the opening of the Panama Canal will still further dislocate trade routes, just as did the opening of the Suez Canal. It places New York, New Orleans and San Francisco in a far different relation from that which they previously occupied.

The recently inaugurated Federal Reserve Bill makes possible the development of branch banks and the working out of international credit, which will go hand in hand with the upbuilding of over-seas traffic and the merchandise and consignment business that exists in countries where free trade prevails.

Finally, America is the natural country to be the counter or clearing-house of the world. Our seacoasts face every other continent. This country is the greatest of all reservoirs of raw material and food supplies. It has unlimited iron, coal, copper and other mineral resources. In the iron and steel business and in other industries that are easy to standardize we are in position to compete with the world. But these advantages are of limited value to us so long as means of cheap and expeditious transportation are denied, or so long as it is necessary for our products to pass through foreign hands. And these conditions, the upbuilding of our marine, the development of our foreign trade, the extension of international financing depend upon means of clearing away the obstacles which now place America at a disadvantage in comparison with the free ports of Great Britain and Germany, which are the present clearing-houses of the world.

ECONOMIC IMPORTANCE OF AMERICAN NEUTRALITY

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NEUTRALITY, regarded as a conception of international law, "consists in abstinence from any participation in a public, private or civil war, and in impartiality of conduct toward both parties."[1]

Its basic principle is plainly that of a limitation of war to the belligerent powers directly concerned. But neutrality in its practical applications is more than this. A distinct relation arises at once between the contending governments and those bearing no immediate share in the conflict, and situations are ipso facto created pregnant with the gravest complexities and responsibilities. It is, indeed, in this day of a highly expanded world commerce, impossible that the disasters of war should be wholly confined to the actual belligerents. The neutral will inevitably experience some phases of the general loss and damage, since each belligerent must, by universal consent, be allowed to so far restrain commercial intercourse with the opposing belligerent as to insure the cutting off of all intentional or incidental neutral aid. Neutrality, to be genuine, can know no degrees whatsoever, no divisions, no limits; it must be absolute and unconditional; should it be permitted to develop, under a specious pretext of safeguarding its own economic interests, any quality of *relativity,* it at once incurs the peril of becoming essentially less aloof from the interests of one side than of the other, and undeniably open to the charge of partiality. A neutral power may not even be permitted to vary its required attitude on the plea that proposed deviations may benefit the belligerents equally; since an identical concession or absence of restriction must operate with varying effect on those whose local environment is dissimilar. Such an imperfect neutrality becomes in substance a participation in a belligerent struggle. We need not, of course, stop to point out the distinctions arising from a *partial territorial* neutrality such as exists in the Savoy districts of Eastern France and where, should war occur between France and Italy, the districts in question may be occupied by Swiss troops to preserve the neutralization accorded this region at the Congress of Vienna. The very fact of neutralization, indeed, would appear to properly imply a prerogative of defense by force of arms if need be. Upon two celebrated occasions (in 1780 and in 1800) the states of northern Europe agreed to maintain, with their allies, certain dogmas of maritime neutral regulation by force of their combined fleets and troops, nor were these "armed neutralities" thought to derogate from true neutral character. Exceptions, too, are seen in the beneficent activities of the Red Cross and ambulance service, and in such cases as may justify a neutral in granting pilotage assistance to a disabled belligerent or in permitting him to take supplies of fuel limited by the requirements of distance to his nearest national or colonial port. But in such a crisis as confronts the world to-day, the chief stress of international perplexities arises from the threatened interests of commerce,—the detention by a belligerent of goods claimed as contraband, whether destined to an opposing belligerent or to neutral territory whence transshipment to belligerent territory is considered more than probable; or, again, the

[1] Fuller, C. J., in the case of *The Three Friends,* 166 U. S. 1, 52, March 1, 1897.

question of permitting by a neutral the domestic manufacture and sale or export to belligerents of war munitions. For the moment we may lay out of view problems arising from the exigencies of *blockade,* since this weapon has not as yet formed a feature of present-day hostilities. In time of war the trade of neutrals with belligerents in articles not deemed contraband is absolutely free unless interrupted by blockade which seeks to forbid all traffic irrespective of the character of the goods.[2]

The term contraband, however, marks a sharply differing conception. It is applied to certain classes of merchandise intended on the part of a neutral for belligerent use, but whose seizures by an opposing belligerent is permitted on principles of international law; the merchandise is *under the ban—contra bannum*—and its carriage becomes thus tinged with an illicit quality susceptible of enforcement, not by the neutral's government but rather by that of the belligerent. It is the goods themselves, indeed, and not the shippers which are the objects of this ban. The government, with us, of the shipping neutral is not properly concerned save where the transaction is brought within our neutrality statutes by assuming the form of an *organized* warlike undertaking, such as the fitting of a predatory vessel or one intended to afford assistance to belligerents or insurgents, as set out in the Act of Congress of 1794

recommended by President Washington in his annual address on Dec. 3, 1793; it was drawn by Hamilton; and passed the senate by the casting vote of Vice President Adams. Its enactment grew out of the proceedings of the then French Minister which called forth President Washington's proclamation of neutrality in the spring of 1793.[3]

But with the strictly individual manufacture and sale to a belligerent of war munitions the case is wholly dissimilar; Jefferson wrote, May 15, 1793, to the French and British ministers at Philadelphia:

> Our citizens have always been free to make, vend and export arms; it is the constant occupation and livelihood of some of them. To suppress their callings, the only means, perhaps, of their subsistence, because a war exists in foreign and distant countries in which we have no concern, would scarcely be expected. It would be hard in principle and impossible in practise. The law of nations, therefore, respecting the rights of those at peace has not required from them such an internal derangement in their occupations. It is satisfied with the external penalty pronounced in the President's proclamation, that of confiscation of such portion of these arms as shall fall into the hands of any of the belligerent powers on their way to the ports of their enemies. To this penalty our citizens are warned that they will be abandoned; and that the purchases of arms here may work no inequality between the parties at war, the liberty to make them will be enjoyed equally by both.[4]

These expressions of the construction placed upon neutral rights are quite as valid for the exigencies of to-day as for those of 1793. Our

[2] *The Peterhoff,* 5 Wallace, 28, 56.

[3] 166 U. S., 52.

[4] Ford's "Writings of Thomas Jefferson," Vol. VI., pp. 252–257.

government then wisely determined to enforce no restrictions proceeding from itself against domestic commerce, but it did recognize, and very clearly, that with the *belligerent* the case was radically different and that it had in international law a well-defined right to seize such goods as could properly be classed under the denomination of contraband. But the undeniable privilege of a belligerent to seize contraband becomes complicated with neutral commercial rights when the goods in question are *primarily* destined for a neutral port. The problems thus arising are concerned with the true and not merely the apparent destination of the goods; the better view and one which seeks to regard the whole carriage of the goods as a single shipment irrespective of whether a brief stoppage is to take place in neutral territory before forwarding to the belligerent, is known as "continuous voyage." This doctrine was developed by the British Admiralty courts from the so-called "rule of 1756" by which was meant that Great Britain would not consider valid a shipment of merchandise carried between colonial ports and the mother country by neutrals who were excluded from such a trade in time of peace.[5] This theory of continuous voyage was enforced by our own Supreme Court in the celebrated case of the *Peterhoff*[6] and in other cases arising through our civil war, where European trade with the confederacy was attempted through West Indian or Mexican ports. The Declaration of London (1909) sanctions continuous voyage as applied to *absolute* contraband, that is goods which are preeminently those of *war;* with merchandise equally suitable for war or peace uses, *i. e.,* for *conditional* contraband, however, the Declaration requires that an immediately hostile destination shall be shown to justify seizure. But the extraordinary development in military and naval war-making instruments, vehicles and methods, of the last few years which has brought the realm of the air into use as a theater of actual campaign, must inevitably lead to the widening of classes of contraband; a similar remark might be made touching the development of *submarine apparatus.* In cases where material unquestionably destined for use in the manufacture of aerial or submarine apparatus or in their maintenance is consigned in war time to a neutral country which can have no such use for these objects, but which lies adjoining belligerent territory where they are indispensable, it seems impossible to suppose that such material can be excluded from the class of absolute contraband and thus become open to belligerent seizure.

With questions arising from the possibility of such belligerent capture as between two or more governments actually at war, a neutral nation can have, of course, no concern. The equal or unequal course of belligerent fortunes should not be allowed to become in anywise a neutral's affair. For the neutral, the rules deemed sound by the acknowl-

[5] Case of *The William,* 5 Christopher Robinson, 385, where a vessel was not allowed to claim stoppage in a neutral port to justify colonial trade.

[6] 5 Wallace, 28.

edged law of nations and the principles of that law in their legitimate development and expansion must prove controlling, whether they contemplate a temporary abridgment of neutral commerce or whether they justify its prosecution in channels sanctioned by the highest authority. The effect of such rules as between those engaged in war, however, should properly be left to the decision of their forces or opportunities such as they may be. For both neutral and belligerent, nevertheless, international law as crystallized in our own country and in Great Britain by executive action, by the carefully considered decisions of the highest courts, and by legislation in harmony with acknowledged principles of international law, point out the only safe pathways and those in which both governments and individuals should find their truest advantage.

FUTURE BANKING PROBLEMS OF THE UNITED STATES WITH REFERENCE TO THE EUROPEAN WAR

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PUBLIC opinion in the United States concerning the effect of the great European war upon this country has passed through several distinct stages. The first period was of brief duration. Many people, recalling the prosperity of this country during the Napoleonic wars, jumped to the conclusion that it would bring financial and commercial prosperity to us.

This delusion, for such it may be termed, was rudely shattered by the consequences which followed thick and fast during the first few days of August. Our stock exchanges closed even before war was officially declared, the cash reserves of our banks were reduced almost over night below the minimum prescribed by law, emergency currency in very large amounts must be issued, interest rates soared, banks advised retrenchment and caution, orders were cancelled, factories closed or operated only part-time, while cotton became not only unsalable, but of unknown value as collateral.

In the face of such circumstances, of which these instances are illustrative, public opinion entered upon the second stage. Pessimism abounded. Fears for the safety of friends and relatives abroad, coupled with highly colored, but inaccurate, news from the seat of war, led to the greatest apprehension. We came to regard Europe as wholly mad, destroying everything; suddenly bereft of all business prudence or sound sense. In this period arose the hysteria of a German invasion of our shores, although a hundred times further removed than the English coast, apparently unattainable to her. During this period arose the dread of uncontrollable foreign liquidation of American securities and of our banking system, drained of every dollar of its gold reserve. Happily this period of horror and depression has nearly ended.

We are now in a more cheerful frame of mind. On every side one hears the hope expressed that we have passed through the worst of the effects of the European war. It was inevitable that the sudden outbreak of the struggle, coming without warning, should disorganize the machinery of production, and cause universal hesitation, retrenchment and caution. It is argued that the American business man has had an opportunity to survey the situation, to ascertain to what extent his trade has been affected by the new conditions, and that now, after five months of study, he is prepared to once again push forward along the lines which have been least affected by the changed conditions.

This more cheerful frame of mind is stimulated by the news leaders in our daily press. Mr. Charles M. Schwab's alleged interview, in which he asserted that there were over $300,000,000 of orders for war materials in process of manufacture, has been given the greatest prominence. Every mill which has received a contract or to which an inquiry, real or alleged, has been directed concerning the sale or manufacture of blankets, automobiles, cartridges, rifles, cannon, clothing, harness and saddlery, oil, copper, and in fact the vast range of articles which are being consumed in this struggle, has been given prominence.

In spite of this optimism we must realize that in New York City over one hundred thousand men are out of work, while the army of unemployed in the entire country is estimated by responsible observers to be as high as one million in number. As Judge Gary, of the United States Steel Corporation, has well said, the need for aid for the unemployed is perhaps greater than the need of the sufferers in Belgium. Nor does such a conclusion proceed from any failure to appreciate conditions in the devastated regions. No one can understand the want or misery which will afflict millions of deserving, thrifty people in Europe. With the German casualty list much delayed, thereby minimizing the totals of killed, wounded and missing; with France and Russia unwilling or unable to announce but a small fraction of their losses in men; with the English losses largely to come, because only a small proportion of the allied army has thus far been made up of her troops, the world has yet to realize the tremendous destruction of workers which the war has already entailed and which each additional day will bring. Any estimate of this loss is at best but an approximation, but it seems likely that the first six months of the war will involve a loss of life greater than the entire loss on both sides in the four years of our civil war. Sociologists and the medical profession will, for a generation, be investigating and reporting upon the consequences, direct and remote, of the killing and maiming of such an enormous number of men.

It is natural, under such circumstances, that popular attention should give little or belated recognition to the tremendous losses in property which have occurred and which will occur. Popular interest seems to be chiefly concerned with the destruction of the architectural

monuments of the past. As to the destruction of factories, warehouses, roads, bridges, farm buildings and machinery, fences, dikes and canals, but little attention has been given.

We are appalled by the assertion that millions of Belgians are homeless and without means of support, particularly when told that a vessel load of food is needed every day to keep these people from actual starvation. We are only beginning to realize that this tremendous toll upon the charity of the world, largely upon the United States, must continue for many months, because the means by which this population can earn its own living have, to a large extent, vanished through the destruction of the agencies of production. Thus far we have heard little of the needs and condition of northern France in which a population almost as large, ordinarily finds employment, and where the destruction of property must have been fully as great.

We think of the losses and cost of the war as involving only the expenses of the belligerent governments, and yet this is the smaller part of the permanent drain upon the world. If the war should cease to-day, the belligerent nations would be solvent and could carry the enormous burden of debt which they have been forced to assume. The greatest loss, the suffering, privation and disorganization will come to the people of those districts over which the armies have tramped.

Lord Kitchener tells us that the war will take at least three years, if it is fought to a finish: there is no reason to presume that this estimate is not correct. A finish, as he views it, involves the gradual wearing out of Germany; the pressing back of her armies until they are forced to surrender at the gates of Berlin. If his hopes are realized, the losses of the war will be tremendously increased, for the path of ruin and devastation will reverse its course and Germany will, at the end of the struggle, be fully as devasted as are Belgium and northern France to-day.

It is folly for any one, at this stage, to estimate the effect of the war upon American business and American financial conditions. From the few illustrative facts which I have set forth above, it is apparent that the duration of the war and the extent of its devastation will to a large degree, determine the effect of the conflict upon us. It has been apparent to every one that the duration of the struggle will directly affect its cost. The greater the cost, the larger the sacrifices which must be made, and the larger these sacrifices, the more profound will be the effect of the war upon neutral nations. We must bear in mind that the ability of the nations of Europe to bear the financial burdens of the war depends upon the extent to which their territory is ravaged and their lands, buildings and public works destroyed.

The governmental expenditures of the war, in so far as intelligent estimates can be made at this time, are running at the rate of $20,000,000,000 a year. The investment in new securities by the people of the

countries at war, have heretofore been at the rate of about $4,000,-000,000 per year. Even making all allowances for the diversion of capital from manufacturing industries to war loans and the results of unparalleled economies, it is apparent that the struggle is running far ahead of the normal rate of investment in times of peace, when business is going on and profits are being made by the belligerent nations. It is this disparity between saving power and direct and indirect expenditures which has given rise to the ever-present dread of an enormous liquidation of American securities.

There seems to be a persistent tendency to minimize and underestimate the foreign holdings of American securities. I have seen no newspaper or magazine which openly expresses doubt as to the extent of these foreign holdings, support its conclusions by reference to the painstaking official and unofficial studies of this subject made by foreign governments and by financial experts in times of peace. And yet every student of finance ought to be familiar with such a study as that made by Sir George Paish for our National Monetary Commission in 1909, if not with the original sources from which he drew his information. Five years ago, Sir George, in his scholarly study "The Trade Balance of the United States," declared:

> Great Britain possesses about $3,500,000,000 of American securities. . . . The French investments in the United States, including the Pennsylvania Railroad and other loans placed in Paris, since 1902, amount to nearly 2,500,000,000 francs, or $500,000,000. . . . German bankers place the amount of German investments in American securities at about $1,000,000,000. The amount of Dutch capital in the United States is about $750,000,000. American securities are also held by Belgium, Switzerland and other countries. In the aggregate, the amount of European capital invested in *permanent*[1] securities in the United States is approximately $6,000,000,000.

The British chancellor of the exchequer stated in the House of Commons, on December 1st, that "America, I suppose, owes us nearly £1,000,000,000 in fixed and floating capital," and in a later explanation he declared that he had reference to the British capital invested in the United States and in no way had in mind current American indebtedness which had been the subject of the discussions between Sir George Paish and the representatives of the United States treasury. We must bear in mind, moreover, that the indirect effect of English holdings of securities of corporations on the North American continent may be very profound. The general manager of the Bank of Montreal, in his address to the stockholders, at the annual meeting held on December 7, declared that British investors had, for a considerable period, been placing on the average $25,000,000 per month in Canada. Such investments had ceased with the outbreak of the war, and as he remarked,

> This monetary deprivation, coupled with the necessity of using her earnings and income for the purpose of paying Great Britain interest on our indebted-

[1] The italics are mine.

ness of $2,800,000,000 to London, has brought home to us the extent to which the London money market and the British investor have been our friends, indeed, our partners in what might be termed this colossal Canadian enterprise.

Continuing, he throws an interesting but thus far little-noticed side light upon the effect of this sudden change upon the foreign trade of Canada and in fact of South America and all relatively undeveloped countries. He well states that

> The trade situation we are now facing is that, owing to our present inability to borrow by public process in the London market, we seemingly must limit our imports to the approximate volume we are able to pay for in exports, or we must borrow elsewhere; that is, in the natural assumption that we wish to avoid reducing our cash capital. There is an alternative, for it will be obvious to the most uninitiated that if our good neighbors in the United States desire us to purchase from them in anything approaching the volume of the past, they must, at least during the war, while the London market for public flotations is closed, provide us with the wherewithal in the shape of loans to our principal public borrowers. If they adopt this course, and a commencement has already been made, it will be clearly advantageous to them and to Canada.

Thus it would appear that, at a time when we ourselves are fearful of having to repurchase securities from England, our Canadian, and perhaps also our South American neighbors, are looking to us to maintain our foregn trade with them, in a measure taking the place which England has heretofore held, by investing money in their enterprises.

It would be well for economists and bankers to read at this time Sir Robert Giffen's celebrated essay on "The Liquidations of 1873–76." This advice is especially apropos for those who see such rosy prospects for advantageous trade in South America and the other relatively undeveloped areas of the world. If history repeats itself the greatest danger, in a financial sense, will occur after the close of the European War and will be particularly great in the countries of South America, Central America, Canada, in fact all of the relatively undeveloped areas of the world. I do not want to be understood as discouraging the development of South American trade, but American manufacturers and exporters must proceed with great caution. They must look carefully to their credits; they must not manufacture goods without understanding the conditions of these markets; they must not overstock, nor put too large a portion of their capital into this field; they must be prepared to take losses and look for a larger proportion of losses than in the territory with which they are already familiar. Crusading for business of this character is expensive. It means no immediate profit. It is an investment which will yield dividends in the distant future. In short, it is the sort of business which can only be handled by rich, well-established, prosperous concerns, which take it on as a side line, and which go into it upon the assumption that it is not an El Dorado, but that it involves a long and perhaps expensive campaign, the profits of which may be delayed for years.

But we have wandered somewhat from the subject of foreign liquidation. Those little versed in financial matters believed that this liquidation would come suddenly, in a day or a week, and that for this reason the exchanges could not be opened. The fact that the opening of our stock exchanges has not brought out a deluge of securities, such as overwhelmed them in the last days of July, is taken by some people as a proof that no liquidation will occur. Both assumptions are contrary to good sense and to the normal operations of finance. The tremendous outpouring of securities which became so embarrassing a few hours before the outbreak of the European struggle, was the result of an entirely different situation than that which prevails at the present time. A good deal of it was the work of speculators who had been carrying margin accounts and who, becoming frightened at the war clouds overhanging Europe, decided to seek safety. A large share of it was prompted by the desire of foreign financial institutions and commercial interests to make preparation for the storm which had so suddenly brewed. It was apparent if war should come that a period of isolation, uncertainty and ruin would follow. Far-sighted financiers thought that a credit balance in the United States would be of assistance both in settling transactions already entered into, and in connection with future problems, after present-day obligations had been handled. The Bank of England was caught unprepared. Its gold reserve was dangerously low, compared with the burden which it must suddenly assume. Gold instead of coming to it, was being withdrawn, and it was evident that drastic steps for the replenishment of the gold stock were necessary. Thus we had general moratoria and the calling of short-time loans which American bankers have habitually made during the summer against credits to be built up through the sale of cotton and grain during the fall, and which normally amounted to $400,000,000 and upwards at the end of July. The clearing up of this current borrowing has really been the object of the conferences between the representatives of the British treasury and American bankers.

The editors of *The Commercial and Financial Chronicle* and of a few other publications have performed a notable service in pointing out the unfairness of England's position with reference to this current indebtedness. Shielding herself behind a moratorium—a self-declared stay-law—postponing indebtedness without regard to the necessities or the desires of her creditors, and at the same time demanding of us the repayment of our obligations on the day when due, and in gold, she has, to a large degree, emphasized and intensified the disorganization which the war would cause, and has, by this purely arbitrary and one-sided arrangement, drawn from us practically all of the gold with which the position of the Bank of England has been bolstered up. I wish to reassert, in the strongest possible terms, the very wise position which these authorities have taken, that we must not play a maudlin and uncertain

part with reference to the further exportation of gold. Our financial system is undergoing a radical change—a long-delayed readjustment—and it is suicidal for us, as a nation, to so manage our affairs that we shall be forced to continue to ship abroad additional amounts of gold.

Now that our current indebtedness has been satisfactorily adjusted, the only likelihood of a further withdrawal of gold will come from a liquidation of securities. Having postponed the opening of our stock exchanges until this current indebtedness was adjusted, it is reasonable to conclude that this fear of a wholesale liquidation has been very much exaggerated and that, as a continuing menace, it has been unduly magnified. I am confident that if the stock exchanges and banks cooperate in an intelligent and unselfish manner, foreign liquidation can be controlled according to our desires and convenience. If it becomes known abroad that it is the unalterable decision of American bankers that they will not enter upon or continue in any enterprise which involves the exportation of additional sums of gold, the greatest danger through foreign liquidation will have passed.

Broadly speaking, the only gain which foreign interests can achieve from selling American securities is either to obtain gold from us, with which to purchase in some other market, or in order to build up a credit balance in this country, against which they may draw in payment for merchandise, foodstuffs and munitions of war bought from American manufacturers or exporters. When we shut the door on gold exportation—and it is possible to do so—then we have nothing to fear from the sale of American securities, in order that funds may be secured to purchase American commodities. We will be selling commodities at our own price—at a good profit—and buying securities, representing ownership in properties untouched by the war, at bargain prices. We have everything to gain and nothing to lose, providing we, as a nation, can regulate the extent of the transaction.

Perhaps there are some who will feel that this is a selfish position for us to take. There has been a great deal of misapprehension concerning the ethics which should determine our position with reference to repurchasing securities owned by foreign investors. In so far as this misapprehension is the result of overwrought sympathy for this or that belligerent, no comment is necessary, but so much of it as proceeds from an honest and sane misapprehension warrants respect and attention. We must remember that the foreign holdings of American securities represent the accumulation of half a century. To ask us to repurchase the securities which we have sold during fifty years in one year, much less in a day or a month, is preposterous. A considerable part of the difficulty which many people experience is the result of fundamental misapprehension as to the nature of these securities. They do not distinguish between securities and money. No one will dispute that if foreign investors held a large amount of American paper money,

this must be redeemed upon demand, no matter what sacrifices this would entail. The essential characteristic of paper money is that it shall be redeemed without question *upon demand,* but paper money and securities are entirely different. The first is a call for a standard dollar —that is gold; the second is a certificate of proportionate interest in either the mortgage on a property, or in the ownership of that property, as the case may be.

No one would ask that an American householder should repay the mortgage upon his home, which, by its terms, was not due for some years, simply because the English holder of the mortgage suddenly decided that he wanted his money to assist his government in prosecuting the war. No one would contend that it was the duty of the ranch owners of Texas, for example, to repurchase a ranch owned by British interests, solely because of the problems which the war brought to the foreign owners, and yet this is exactly the position which they take with reference to the stocks and bonds of our American corporations. The foreign security holder is either a creditor or a partner in our enterprises. He has gone into them with the expectation of profit and with the assurance that his money is safe. We have done nothing to endanger the safety of his investment, and whatever unfavorable features may have developed concerning the profits of the enterprise arise largely out of the war, which we have not caused and from which we are an innocent sufferer.

There is no moral obligation on our part to repurchase these securities. Such a contention proceeds upon the assumption that we have made an enormous call loan in Europe, and that it is understood upon both sides that Europe may and will call for its repayment whenever home conditions make it advisable. Such a contention is utter folly. American financiers would never have entered into such an arrangement, and had they been so foolish as to make such enormous call loans, they would have demanded the rate of interest which properly attaches to such a class of loans. The plain truth of the matter is, that Europe has never regarded these investments as call loans. They were made because of the attractive rates of interest which they offered—from 50 to 100 per cent. higher than the rates which could be commanded for call loans. Our European friends have made the extra profit of a permanent investment, and they must now abide by their choice and convert their investment into liquid funds at our pleasure and not theirs.

If we agree as to the ideal and purpose which should be followed with reference to our financial relations with Europe, let us see to what extent this ideal can be achieved. In the beginning there is nothing mysterious or magical about the entire situation. So long as Europe does business according to the terms of her contracts with us rather than postponing payment by moratoria, most of which have now happily ended, there is no reason to fear a further and considerable exportation of gold, in so far

as the purchase and sale of commodities are concerned. On the contrary, the likelihood is that, aside from the securities problem, the movement of gold would tend in the opposite direction. Incomplete trade statistics show that the trade balance is running heavily in our favor, and that if present tendencies continue the balance of trade in favor of the United States will run considerably higher than in ordinary years. This is in part due to the prostration of European manufacturing industries, which has led to a reduction in our imports, and is in part the result of increasing exports of food stuffs and certain classes of manufactured goods, the demand for which has been stimulated by the war.

We must bear in mind that the United States, being a debtor nation, must normally have a surplus of merchandise exports over imports, if the exportation of gold is to be avoided. Estimates by leading authorities on foreign trade and foreign exchange agree that this excess of merchandise exports over imports must range somewhere between $400,000,000 and $600,000,000, in order that we may be able to square our accounts without the shipment of the precious metals. This excess of merchandise exports, whatever may be the correct figure, is needed to enable us to pay interest and dividends on foreign security holdings of from $200,000,000 to $300,000,000; the expenditures of our tourists abroad, estimated at $150,000,000 to $200,000,000; the remittances by Americans to friends and relatives in European countries, estimated at $100.000,000 to $150,000,000; and payments to foreign ship owners for freight, estimated at $20,000,000 to $40,000,000. With our merchandise exports running above normal and our imports running considerably below normal; with a likelihood that tourists' expenditures during the coming summer will practically disappear; and with the encouraging news that remittances in the past few months by persons in this country to friends and relatives abroad have materially decreased, it seems altogether probable that we shall have a *real* excess balance in the neighborhood of $300,000,000 a year which can be used for the repurchase of American securities.

As the war develops and the need of foreign nations for munitions and supplies increases, due to the exhaustion of stores accumulated in peaceful times, it is reasonable to presume that our exports of merchandise may still further increase, and that our ability to absorb foreign-held securities will correspondingly grow. There is no more reason why it would be wise for us to demand the return of gold for our credit balances than it would be for Europe to continue to draw upon our store of gold.

If we are correct that our commercial balance of trade is satisfactory, there only remains for consideration the possibility of achieving the ideal of controlling foreign liquidation in American securities upon our own terms rather than upon theirs. I believe that this is possible,

and may be accomplished, provided there is the proper degree of co-operation on the part of the stock-exchange interests, our bankers and our corporations. We must bear in mind that our stock exchanges are working on a basis of minimum prices. We have already seen, in a modified form, the efficacy of this device. A heavy selling movement will force a stock down to the minimum price, as, for example, was the case on several occasions with Steel common. When this occurs, selling ceases or must be limited to the ability of the market to absorb the stock at the minimum price. In other words, the *buying* movement determines the amount which shall be sold. The seller can not offer his stock at lower prices and force the financial interests, in self defence, to purchase. It is altogether likely that minimum prices will continue to be readjusted, some advanced and others lowered. The existence of minimum prices will be of the greatest advantage in controlling unwelcome liquidation. Should additional checks be found necessary they can be speedily devised and applied. Stock exchange members could be required, for example, to guarantee that securities sold by them are not for the account of citizens of belligerent nations, that at the time of sale the brokers actually possess or control the securities (which can be made effective by requiring the broker to give the numbers of the stock certificates or the bonds at the time of the sale). Most of these devices are successfully used in London.

When it becomes certain, as it should speedily appear, that the fear of uncontrollable liquidation of American securities is groundless, so long as we manage our affairs with intelligence, the investment situation in this country will rapidly improve. It is idle to presume that the amount of money available for investment in new issues of American securities will be as great as heretofore. It is altogether likely that the amount of European capital in this country, entirely aside from the resale of securities to us, will markedly decrease. It is estimated that the outstanding funded obligations of the leading railway and industrial corporations of this country that must be met at various dates throughout the next three years are $1,241,573,536, of which $764,424,289, or more than one half, is due in 1915. Our first task is to make provision for refunding or extending these maturing obligations. A certain percentage—no one seems to know how much, although the percentage is probably comparatively small—is held by foreign investors. It is altogether likely that part of the liquidation, so much feared, will consist in a demand for the repayment of these obligations as they mature. Most of them were sold at a price below par. The issuing corporations are obliged to redeem them at par. It is obviously more advantageous to demand the payment of these securities at par than to sell us other securities at prices much below par. We have already seen something of the working out of this proposition in the recent refunding of the City of New York's obligations, where this tendency was strikingly apparent.

The refunding of outstanding loans should provide a considerable activity in securities during the year 1915. If we act intelligently and set our face against foreign liquidation of American securities there is no reason to presume that a fairly good security market will not exist. The most salable securities will be short, time obligations of municipalities, and of corporations whose earning power has been tested and found satisfactory. I refer not only to short-time notes, but bonds with five- to fifteen-year maturities. If our municipalities will borrow only for productive purposes, or where the need for additional public facilities is really existent, if they will put out short-time securities, or are willing to pay higher rates of interest, it is altogether likely that the municipal bond market will show considerable activity.

If it were possible at this time to cut out the sale of wild-cat and relatively worthless securities, the extermination of which is the aim of all blue-sky legislation, we should, to a large degree, solve our immediate problem as regards new capital. No one can tell the enormous aggregate capital which is lost every year through the sale of securities promising large returns, which are never achieved. The problem of the security market consists largely in the weeding out of these undesirable "securities." In other words, in making good the loss of our foreign clientele, practically all of whom go into our better-class securities, we must turn the stream of money now wasted in worthless schemes into this channel. Perhaps one of the few permanent benefits of the war may be that it will bring about a conservation of investment funds.

It may be remarked in conclusion that as the war progresses and the financial exhaustion of the belligerents becomes more marked the danger of liquidation will steadily increase. As some one said, the belligerents of Europe have passed through the honeymoon stage of their war financing. The Bank of France, without any increase in its gold reserve, has expanded its note issue 3,300,000,000 francs—roughly the amount of its advances to the French government. There has been a tremendous expansion both in note issues and in the deposit credit structure of the Bank of England, the Imperial Bank of Germany, in Russia and in the Netherlands. The situation is feverish to say the least. It behooves us to proceed with caution, to maintain our insular position, not only in a political, but in a financial sense; to keep our own needs and interests always in the forefront. The longer the struggle, the greater the tendency of a financial cataclysm, and even though the world succeeds in avoiding this added misfortune, while the war continues, the financial problems of peace have many times proved more difficult of solution that those of financing the struggle.

A HISTORY OF TAHITI. II

By Dr. ALFRED GOLDSBOROUGH MAYER
CARNEGIE INSTITUTION OF WASHINGTON

BUT now an era of greed and hate had come, and as traders scattered firearms among the chiefs, war degenerated into murder, and in an orgie of viciousness inspired by drink, degraded by vile whites, and depleted by introduced disease, the natives dwindled rapidly. The vast numbers seen by Cook and Wallis were no more. In 1798 William Wilson estimated the population at only 16,000, but in 1802 according to Jefferson and Scott, it was not greater than 7,000 and, Ellis says the death rate exceeded the births until 1820 when other influences developed which tended to stem the tide of extinction. But Admiral Wilkes states that up to 1839 the births and deaths were almost exactly equal in numbers, and even to-day there are not more than 7,000 natives on the Island of Tahiti.

This fixity of population after an initial period of decline has been observed elsewhere in the South Seas. In Tahiti it was due mainly to the introduction of Christianity, which prohibited infanticide and human sacrifices, and checked native warfare. At the same time, however, the adoption of Christianity contributed to the increase of certain fatal diseases, notably tuberculosis, through the enforced wearing of dirty European clothing, and the too hastily effected efforts of European teachers to develop "the family ties" thus causing the natives to huddle together in unsanitary, ill-ventilated "shanties" of European pattern. The listlessness and loss of interest in life resulting from the prohibition or disuse of old games, arts and crafts, also led to the development of clandestine immoralities and drunkenness, and in many groups the population has decreased steadily and is still declining. Thus in the Marquesas the decline has been from about 20,000 in 1842 to about 3,400 in 1911; in Hawaii from 130,300 in 1832 to 29,800 in 1900; in Tonga from 30,000 in 1880 to 17,500 in 1900; in Samoa from 37,000 in 1849 to 31,300 in 1882; in Fiji from about 140,000 in 1871 to 87,000 in 1911; and in New Zealand from 44,000 in 1881 to 40,000 in 1891.

As the Tahitian proverb said: "The hibiscus shall grow and the coral shall spread out its branches, but man shall cease."

The truth appears to be that after generations of repeated infection, the native blood has developed a partial immunity, although in comparison with the Caucasian, the South Sea Islander still remains deficient in ability to resist disease.

All through the hideous period initiated by the coming of the white adventurer, the decimation due to disease was even greater than that caused by war; for savage warfare consists mainly in ambushing solitary

THE SHORE AT FAAA, TAHITI, WITH MOOREA ISLAND IN THE DISTANCE.

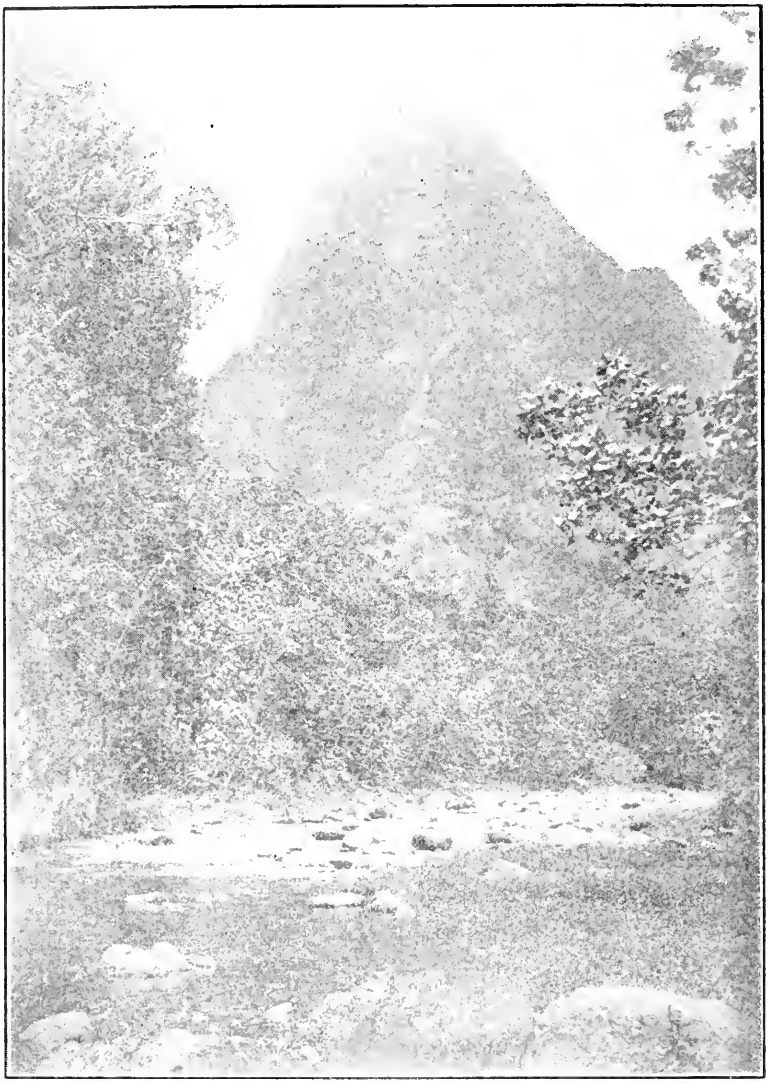
stragglers, rarely in extended frontal attacks, or sieges of fortified positions. Thus in the two years 1864–'65, due to smallpox, the population of Happoa and Taipi valleys in the Marquesas Islands sank from 2,000 to 150. Well might the Samoan father pray to Tangaloa "drive away from us sailing gods [white men] who bring disease and death."

Infinite mischief was wrought during this early chaotic period when every evil invention of civilization was placed in the hands of the natives

Caladiums in a Tahitian Valley.

without check or hindrance to its abuse. The most degraded of our race exerted their demoralizing influence to satiety upon the defenceless natives, and accounts of old voyages bristle with disgusting narratives of debauchery. It became a common thing to kidnap the natives of the New Hebrides and carry them to Australia to work as "indentured laborers" upon plantations. Thus did Chile practically exterminate the population of Eastern Island for the development of her nitrate deposits.

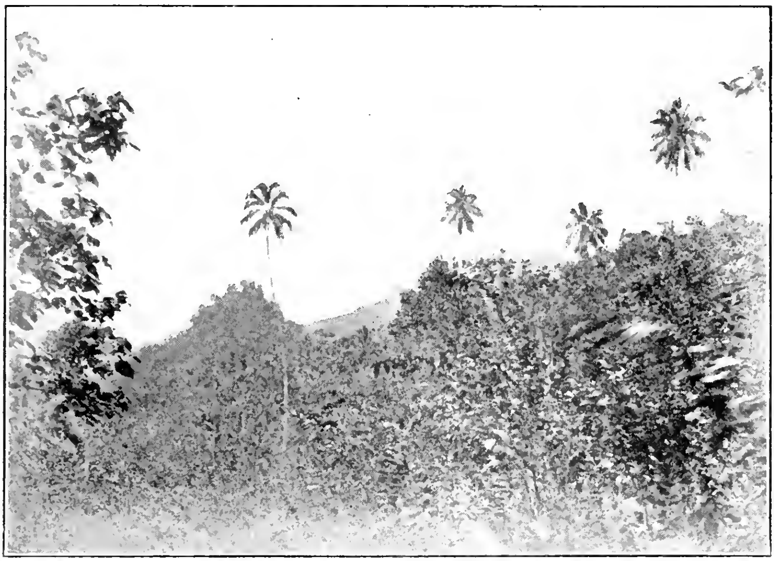
Then in March, 1797, when things were at their worst, a ship whose



PEAK IN FAUTAUA VALLEY, TAHITI.

mission was designed to be one of mercy came to sorrowing Tahiti. She was the *Duff*, under Captain James Wilson, and she brought eighteen English missionaries whom the London Missionary Society had sent into the Pacific with the avowed purpose of converting the natives to Christianity. It is true that in 1772 two vessels from Peru had visited Tahiti and in 1774 Spanish priests were landed, but in the course of a year they had left without making converts.

Pomare and Idia his consort received the strangers kindly and presented them with a large house which had been built for Captain Bligh by the side of the Vaipopoo river near Point Venus. These missionaries were chiefly mechanics, artisans and small tradesmen of nonconformist turn of mind, and the natives were quick to appreciate the advantage



VALLEY OF TAE-O-HAE NUKAHWA ISLAND, MARQUESAS.

which might accrue to them through the maintenance of a forge and a well-equipped carpenter shop; but official enthusiasm cooled when the visitors refused to fashion weapons of war. Still they were more than tolerated for their gifts of axes, knives and cloth, although the chiefs politely requested them to refrain from "parau" (exhortation).

The time was not propitious for the immediate acceptance of Christianity. Diseases of European origin were ravaging the land, affecting almost every family, and the natives were convinced that the white man's god had brought the evils which were destroying them; so when the missionaries prayed, the natives dragged the diseased and the deformed out upon the village green, and exposing them to view, cried, "See what your god has wrought!"

During these early years when many a grave error might have been avoided, the missionaries appear to have lacked a leader whose heart was

great with human sympathy, and who, as Ellis says, would have perceived that

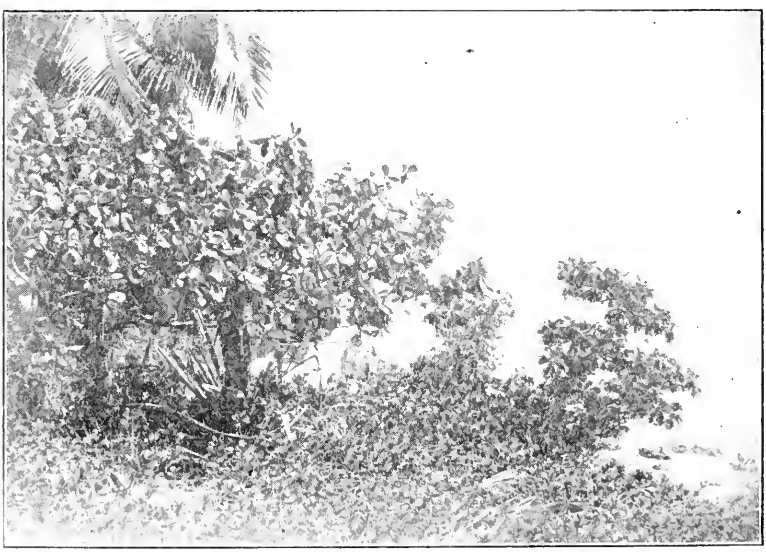
> when the spirit is softened or subdued under the influence of suffering, it is often most susceptible of salutary impression; and the exercise of christian sympathy and kindness in such a season will seldom fail to produce even among the most barbarous tribes highly favorable results.

In place of words of love, these missionaries preached the horrors of hell, in place of poverty they displayed that which was to the natives unbounded wealth; and friendship they sought to win through gifts rather than sympathy.

Before passing judgment upon them, however, it is but fair to pause to consider the probable results had they attempted to pursue the less worldly course. Demon worship was and is the religion of the Polynesian, and even to-day, despite the efforts of generations of high-minded and enlightened whites, the natives cling tenaciously to their god of hate and delight above all in sermons treating of his infinite power for vengeance. Moreover, steeped as they have always been in communistic socialism, personal poverty is unknown and can thus make no appeal upon the side of virtue. Where wealth is naught, power is everything, and it is doubtful whether any considerable number of the natives could have been converted to Christianity even in a century had the missionaries not first won over, or forced, the chiefs to accept their faith.

Moreover, Pomare and all the chiefs realized that this white man's religion would never acknowledge the divinity of their descent, in default of which their authority to enforce the tabu, the keynote of their power, was lost.

Foiled thus in their direct effort to Christianize Tahiti, the mis-



Pisonia Tree, Fakarava Atoll, Paunotus Groups.

Woods in Hamuta Valley, Tahiti.

sionaries, as elsewhere in the Pacific, south to strengthen their position through diplomacy and political activity, hoping thereby to gain the ascendency of power and thus cause their doctrines to become more acceptable to the natives.

Many things have been said and will be said both for and against the missionary, and we must grant that he has done both good and evil, or, perhaps better, we may say out of the evident good he has accomplished some harm has come, for the missionary must needs have had the sympathy of a St. Augustine, the political wisdom of a Pitt, the leadership of a Bismarck, and the Christian spirit of the old bishop in "Les Miserables" to check the reign of death he found around him. What wonder, then, that, being in general but an ordinary man of good intentions, he in some measure failed. There have, indeed, been grand men among the missionaries—such were William Ellis of Tahiti, the Gulicks of Hawaii, and the great John Williams who after twenty-three years of wandering and privation was martyred upon the New Hebrides in 1839. Certainly before they came all was ripening to ruin, and if ruin has come despite their zealous efforts it indicates only that the problem was too complex perhaps for the mastery of any man however good or wise.

Be these things as they may, the nobler and in the end the wiser course would have been attained had these early Tahitian missionaries labored on for years simply to help and to win the respect and love of those around them: and through kindness to gain the hearts of willing converts to their faith.

But reports must be written and sent to London, and upon the im-

pression these accounts would make the continued existence of the mission might depend. The christianization of Tahiti tended in a sense to degenerate into a "business," and as such its success might be measured in terms of time and number. It is only in the sad stern school of experience that we learn in things of charity between man and man, and these pioneer missionaries lacked the advantage of an historic past to point the way to slower but truer betterment of those for whose welfare they labored so zealously.

Moderation, charity and intelligent sympathy are all things of these later years in religion, when as the trappings of the priestly autocrat have fallen away the spiritual leader stands revealed. Expediency suggested the worldly course, and the Tahitian missionaries who at first had declined to take sides in native wars or fashion weapons now gave guns to Pomare, aiding him in his bloody quarrels.

As we read in the "Memoirs of Ariitaimai," a Chiefess of Tahiti, Pomare determined to destroy his rivals and

> knew that what he was trying to do could be done only by wholesale destruction, and that in order to do it he must depend on outsiders; white men, or Raiatians, or savages from the Paumotos. The missionaries knew it also, for Pomare made no secret of it, and yet they recorded it as though it did not concern them.

From this time onward until the French annexed Tahiti the missionaries were the leaders of a party in the State, and the history of the mission is an unwholesome commingling of religious zeal with political aspiration.

Friends they doubtless won, for they were brave and earnest men, but enemies they certainly aroused. Their patron Pomare I. did not take kindly to their doctrines, but he was enough of a diplomat to properly appraise their value to him as aids on his raids of murder. According to the "Memoirs of Ariitaimai" the action of the missionaries is summarized as follows:

> Alternately praying for peace and helping Pomare and Tu (Pomare II.) to make war, the missionaries innocently hastened the destruction of the natives and encouraged the establishment of a tyranny impossible for me to describe. Pomare was vicious and cruel, treacherous and violent beyond the code of chiefly morals, but Pomare was an angel compared with his son.

Pomare II. reveals this policy in a naïve letter which he wrote in 1807 to the Directors of the London Missionary Society and which appears in their "Narrative of the Mission at Otaheiti" published in 1818. In this labored epistle he asserts his firm faith and deep love in Jehovah (he was then indulging in every practise of the Tahitian religion), and after calling attention to the fact that he is beset with enemies, and is the only powerful friend the missionaries have, and that should he die the lives of his dear friends would be imperilled, he ends by expressing his desire for guns and ammunition.

(To be concluded)

THE PROGRESS OF SCIENCE

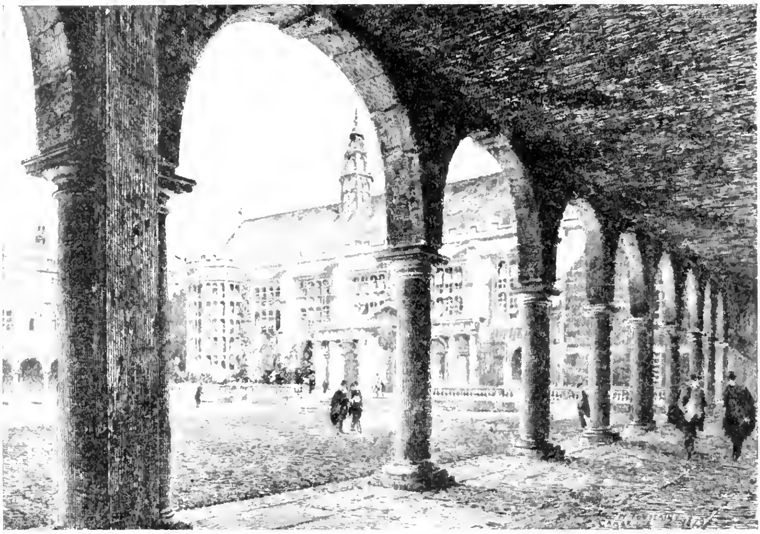
WAR AND SOCIAL PROGRESS

THE present issue of THE POPULAR SCIENCE MONTHLY contains a series of papers presented at the recent Philadelphia meeting of the social and economic section of the American Association for the Advancement of Science, treating more or less directly problems relating to the war. We welcome the opportunity to print these articles, the responsibility for which belongs to our great national scientific association, for it is difficult to know what should be the attitude of a scientific journal toward the war. The appalling magnitude of the disaster crushes everything into insignificance. It seems strange that it is possible for people to talk, read or think about anything else, that they can eat and sleep as usual. But the Greeks knew that both pleasure and pain consume themselves. Hobbes told us that it is the same always to perceive the same thing as to perceive nothing at all. Modern psycho-physical research has established a law that to produce a perceptible change of sensation the increase of the stimulus must be made continually larger as the stimulus becomes greater, until we finally reach a point where no increase in the stimulus will increase the sensation.

It is probably the case that preventable disease, preventable vice and preventable poverty cause each of them every year as much human misery, loss of life and waste of wealth as the war is causing this year. The sacrifice in the war of a million lives and of wealth amounting to twenty billion dollars, is an inconceivable catastrophe. But it is also true that a million children die needlessly in Russia every year, that the annual loss in lives and wealth through the use of alcohol in the several countries is about equal to that due to the war.

We do not expect to see headlines in the daily papers to the effect that five thousand children died yesterday in Russia, three thousand of them through easily preventable causes, or that there was spent in the United States last week four times as much on alcoholic drink as on the whole educational system of the country. It is consequently not surprising that other and even trivial events take their places on the front pages of the daily press beside the war news. But the fact that we become callous with time to the most dreadful conditions or that this war is only one of the evils of the world does not decrease its horror. On the contrary, these circumstances make it more appalling, for after we become used to murder, robbery, debauchery, starvation and disease under the auspices of government, they may be viewed with greater complaisance when due to individuals, and the lives and wealth squandered in the war will for a long time make it difficult or impossible for the nations concerned to reorganize their energies for the advancement of civilization.

On us in the United States there is placed serious responsibility and great opportunity. Clearly we should do what we can to alleviate the misery caused by the war and try to bring it to an end when there is the slightest chance of success, and in a way that will make new wars less likely. We should prepare ourselves for defense, not through military drill or increased armaments, but by education, scientific research and the improvement of social and economic conditions; by the payment of all public debts and the accumulation of surplus wealth under



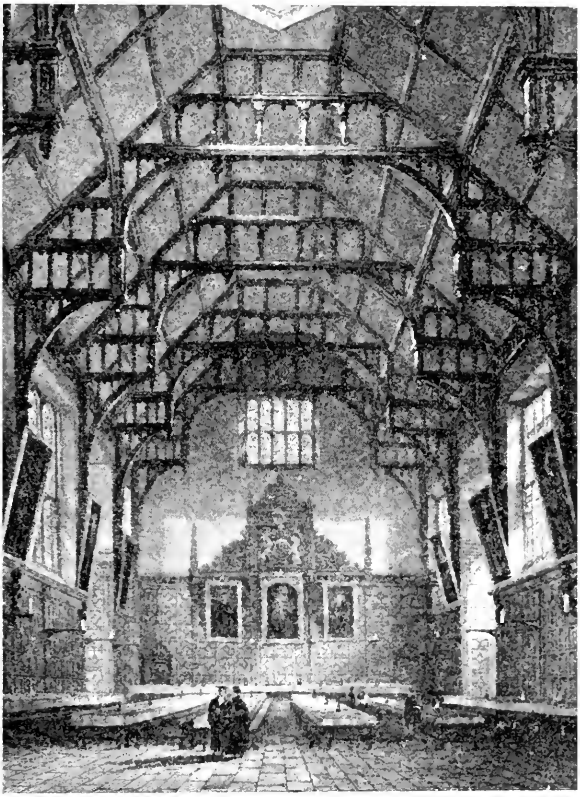
Neville's Court, Trinity College.

public control. If more direct preparation for defense is necessary, a hundred steamships, fast but of moderate size, built here to carry mail, express and passengers to all parts of the world, would be of greater use in case of need than ten dreadnaughts, and far less wasteful in the meanwhile. A million officers and men engaged in works of engineering, public improvement and public service would at less expense or at no ultimate loss be more effective than any standing army of the existing kind. If Great Britain has ten billion dollars to throw into the abyss, we with twice the wealth could easily afford to invest an equal sum for the defense and welfare of the people.

The universities of Oxford and Cambridge have contributed about one half of the men who have given England leadership in government, science and letters. Now two thirds of their students have enlisted in the war; Trinity College has been converted into a military hospital. Could we not select from those who would not otherwise have the opportunity men of ability

Trinity College as a Military Hospital.

equal to the students who have attended the English universities and prepare them for work equally important? And could we not give opportunity to foreign men and women of ability to continue here work from which they will be debarred by the conditions following the war?



The Hall of Trinity College.

PETROLEUM PRODUCTS

Secretary of the Interior Lane has announced the discovery by Dr. Walter F. Rittman, chemical engineer in the Bureau of Mines, working at Columbia University, of two chemical processes, one of which, it is claimed, will greatly increase the supply of gasoline, while the other may make the United States independent in regard to materials necessary for the dye industry and the manufacture of high explosives. Application has been made by Dr. Rittman, on behalf of the federal government, to patent these processes in order to prevent any monopoly in their use, the patents to be dedicated to the American people.

The statement made by Secretary Lane deserves quotation, for even though his opinion of Dr. Rittman's work may be somewhat optimistic, it tells us what we may hope to accomplish by the proper organization of chemical research. Secretary Lane says:

> These processes are fraught with the utmost importance to the people of this country. For some time the Standard Oil Company, through the great

PORTRAIT OF THE LATE DIRECTOR E. A. FUERTES.

Painted by Miss Anna Milo Upjohn and given to the College of Civil Engineering of Cornell University by the alumni who were students there in the thirty years of the directorship of Professor Fuertes.

amount of money at its command, through its employment of expert chemists and through its extensive organization, has had a big advantage over the independents in the production of gasoline, this company having a patented process that obtains for it as much as three times the amount of gasoline from a given quantity of petroleum as the independents now obtain. There are two or three other large corporations that have an efficient process for the manufacture of gasoline, but the independents, as a whole, have never been able even to approach the results obtained by the Standard Oil Company. Now the federal government, through the efforts of Dr. Rittman, proposes to make free for the use of all of the people of this country who wish it, a process that is confidently expected to increase their yields of gasoline from crude petroleum fully 200 per cent. and perhaps more, such results having repeatedly been obtained in the laboratory. It is claimed by Dr. Rittman that his process is safer, simpler and is more economical in time than processes now in use and these are economic factors of great importance. With a steadily increasing demand for gasoline for automobiles, motor boats and engines, this fortunate discovery comes at the proper time. It is but two years ago that the automobile industry, fearful that the supply of gasoline might not be adequate for its rapidly expanding business, offered through the International Association of Recognized Automobile Clubs, a prize of $100,000 for a substitute for gasoline that would cost less than gasoline. Happily the urgency of this situation has passed and at the present time there is a plentiful supply of motor fuel to meet immediate demand. This new process adds to the hope, that in spite of the wonderful growth in the use of gasoline, there may not be any shortage in the future. It indicates an increased production of gasoline from the present production of petroleum—an output of 50,000,000 barrels instead of 25,000,000, as under the present methods. It will render free for use to all, the results of that efficient and intelligent research which has heretofore been only at the command of the wealthy. I am led to believe that it will not only be of inestimable value to the refiners commanding but limited capital as well as those of wealth, but also to the hundreds of thousands of users of gasoline. When it is realized that the gasoline industry each year in this country yields products amounting in value to between $100,000,000 and $150,000,000, the importance of this discovery is seen.

The second process discovered by Dr. Rittman may prove of much more value to the country than the first, in that it suggests the establishment of an industry in which Germany has heretofore been preeminent—the dye industry, and also promises indirectly a measure of national safety of incalculable import. Among necessary ingredients of high explosives used in modern warfare toluol and benzol are in the first rank. Heretofore these products have mainly been obtained in Germany and England from coal tar, and the explosives manufacturers have had to depend largely on the supply from these sources in the making of explosives. I understand that some toluol and benzol have been obtained from American coal and water-gas tars, but this supply does not begin to satisfy the present demands. The federal government now proposes to obtain the toluol and benzol from crude petroleum also. I am further informed that these products can be produced from practically any American petroleum and that the supply can be made sufficient not only for the entire American trade but also for other purposes. This process has gone far enough to indicate that the two products can be produced at a reasonable cost. The real comforting thing, however, is that we have the knowledge that this new source of supply is at the command of our people, and that in time of great national stress, if the nation is ever called upon to defend itself, we shall be able to manufacture the most efficient and most powerful explosives known in warfare. Were it not for this discovery, it is possible that in such an emergency, we might be compelled to rely largely on the greatly inferior explosives that were used in the time of our civil war, and this would spell national disaster.

Dr. Rittman concludes from his experiments that this process may become more economical than the German method of obtaining these products from coal tar, as this process not only makes toluol and benzol, but also gasoline in considerable quantities. He intimated to me the possibility of the value of the gasoline being an important factor in paying the costs of the process. If this should prove to be true, it may result in eventually giving the United States a supremacy in the dye-stuffs industry that has for some time belonged to Germany, since toluol

and benzol are the source of many of these important dye stuffs that are used in the silk, cotton and woolen industries. It would also tend to prevent disturbance of the great industries engaged in the manufacture of silks, cottons and woolens in such extraordinary times as we are now experiencing, for we should be able to supply them with the necessary dyes.

SCIENTIFIC ITEMS

We record with regret the death of Dr. Charles Edwin Bessey, head of the department of botany in the University of Nebraska, distinguished as a leader in botanical research and education; of Dr. T. Wesley Mills, emeritus professor of physiology in McGill University; of Professor James Geikie, the distinguished Scottish geologist, and of Dr. Arthur von Auers, the eminent German astronomer.

Col. George W. Goethals has been made a major-general of the line in recognition of his services in building the Panama Canal. Brig.-Gen. William C. Gorgas, surgeon-general, has been made major-general in the medical department. Col. Harry F. Hodges and Lieut.-Col. William L. Sibert, United States Corps of Engineers, have been promoted to be brigadier-generals. The bill providing for their promotions extended the thanks of congress to the officers.

The Rockefeller Institute for Medical Research has appropriated $20,000 to be used under the institute's direction to further medical research work under war conditions, and is equipping Dr. Carrel's new hospital in France with apparatus for research work on pathological, bacteriological surgical and chemical conditions.

THE POPULAR SCIENCE MONTHLY.

MAY, 1915

EUGENICS AND WAR[1]

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IN the midst of anxieties—national and personal—we meet to honor the memory of Sir Francis Galton, born on this day ninety-three years ago. "I take eugenics very seriously," he said, and we do him honor in following his example, and in considering what most closely concerns us at the present time in the light of what he regarded as of fundamental importance. So we naturally think to-night of war and eugenics.

I. THE DYSGENIC TENDENCIES OF MODERN WAR

In sailing along a coast of which we have no chart we can not tell from a distance whether this or that headland is continued into a dangerous reef or not, but we steer our course in reference to probable risks. Similarly, while we have practically no certainties in regard to the biological effect that a great war may have on a race, some probable risks are discernible. There are more than hints of dysgenic tendencies in modern war.

In ancient days a battle was probably in many cases a sifting out of the less strong, the less nimble, the less courageous on both sides, and the result of a war or raid was probably, in some cases, the practical elimination of the weaker of two clans. In both these ways there may have been a eugenic selection of the types best suited for times when fighting was the order of the day. But times have changed and war with them. Nation no longer exterminates nation, and victory is not necessarily with those of better physique. Moreover among the combatants on both sides the elimination is either indiscriminate, as when a battleship goes down, or in the wrong direction. The finest companies are set to the most hazardous tasks, where the mortality is often terrible,

[1] The Second Galton Lecture, delivered on February 16, 1915.

and the conspicuously brave are particularly liable to be killed. The point need not be labored: what Darwin said of even ancient times is true to-day:

> The bravest men, who were always willing to come to the front in war, and who freely risked their lives for others, would on an average perish in larger numbers than other men.

Our suspicion that war has a dysgenic influence grows when we think of countries with a voluntary system of military service. In the making of our armies there is a process of discriminate selection which works in the wrong way from the eugenic point of view. The call of their country attracts a larger proportion of the more chivalrous, the more virile, the more courageous. In the patriotic response not only in this country, but throughout the Empire, we are proud to recognize a multitude of men of character that is precious. We have to face the fact, of which we are socially proud, that Britain is sending to the battlefields large numbers of the best of her sons, whose early death would mean an impoverishment of the race. They will not all come home. Already one knows of many irreparable losses in fine families.

It is so important to avoid exaggeration that one wishes to hear the other side. It is pointed out quite justly that a large nucleus of genuinely brave men must stay at home to keep things going, and that they form a eugenic bulwark. This is true, but after gratefully allowing for these we can not shut our eyes to the large body of men of military age who can not fight or who will not fight, whose ranks, therefore, will not be thinned as those of the combatants are.

It is said again that elimination is confined to the men, so that the women remain, as they usually are, a eugenic safeguard. But they can not *directly* act in this way unless they have children, and it is to be feared that the war will seriously increase the disharmony already involved in the unwholesomely large number of unmarried women. Moreover we have only to think of the mothers in Belgium and Servia to see that the terrible sifting is not confined to the men. Severe and protracted war tends to lower physical vigor throughout wide circles of non-combatants; the maternal depression, like that induced by famine, tends to result in arrests of development and in the production of under-average types. We have no reason to believe that the germ-plasm is specifically affected, yet it is quite conceivable that very unfavorable nurtural conditions may induce prejudicial germinal variations of a heritable sort.

We are told that many join the ranks simply in a desire for adventure. This is very difficult to prove, but even if it be true, what then? The adventurous spirit is no bad thing, often implying, for instance, a healthy-minded lack of preoccupation with one's precious self. It is

granted at once that not all who are killed are the pick of our race, albeit they may be nobler in their death than many whose safety they have secured will ever be in their life, but is there any getting past the fact that we are exposing to abnormally great risks enormous bodies of men to whose composition there has gone a high proportion of the adventurous, the chivalrous, the virile, and the simply brave? The numbers must be borne in mind. When many brave unmarried soldiers are killed, we are justified in saying that the natural inheritance of the country is the poorer through the loss of many who should have enriched the next generation by more than their example. But this might mean relatively little to the stock if the proportion of combatants to noncombatants was small. It is far otherwise in the present instance. It is said that there are in Britain about 6,250,000 men between 18 and 45, 13.8 of the total population; if we have, as may be necessary, an army of three millions, that would mean almost every second man between 18 and 45. Even if it were every second man by lot, the thinning might mean only a terrible mortality, but if the fitter join the army in larger numbers and are thinned in larger proportions, war must be regarded as a dysgenic eliminator.

It is said that military training has such marked beneficial effects that it counterbalances many losses and disablements, and no one would deny the value of the drill, the discipline, the plain food, the regular hours and all that. But in the realm of life we can not make simple equations of this sort; non-transmissible modifications can not be pitted against innate qualities. Even supposing that all the modifications acquired in the training period are to the good, which they are not, we do not thereby lessen the loss to the natural inheritance of the race likely to be involved in the thinning of Lord Kitchener's army, which includes some of the best brains we have got.

There is another way in which the war is likely to have a dysgenic influence—by handicapping the more individuated. Many of the combatants will never return; many will be maimed and many enfeebled (in spite of the remarkably increased control of disease); but most, we hope, will come safely home. It is too much to expect, however, that they will find things as they left them. Everything promised will be done, we hope, but with the best will in the world things can not be as they were before. Hundreds of millions will have been spent unproductively and there will be need for many economies. This will select in the wrong direction, preventing marriage and so forth, for it will most affect the highly skilled whose work is of a kind that can be more or less readily dispensed with.

Eugenics and war—the clash between ideals and things as they are, is, perhaps, nowhere more terrible than here. For eugenics makes for the maintenance and improvement of the hereditary good qualities of

a race, while severe and protracted war makes for their impoverishment. There is rough sifting, and the meshes of the sieve are not eugenically determined. How far the impoverishment will go is hidden from us, how far it can be counteracted remains to be seen, and what pluses there are to set against the minuses is a question for careful consideration, but some degree of impoverishment is certain.

We are reminded, however, that the race does not live by the germ-plasm alone, and that war with its terrible sifting may be worth all it costs. But who can predict of any war what *all* its cost may be? In his famous essay on "The Moral Equivalent of War," William James said eloquently:

> Those ancestors, those efforts, those memories and legends, are the most ideal part of what we now own, a sacred, spiritual possession, worth more than all the blood poured out.

Perhaps it is so, especially if victory is thrown in! Already in Britain there has been a remarkable widening of sympathies, and waking up to the needs and interests of others.

Every one will agree that there are worse things than war—such as slavery, rottenness, softness, and dishonor; they are worse even than extinction. Let us admit that war may help "to preserve our ideals of hardihood," "to protect human nature against its weaker and more cowardly self," "to keep heroism and the martial virtues alive," and even to re-impress us with the imperativeness of eugenics, but in these concessions let us not admit that there are not tasks of peace capable of evoking and disciplining an equal hardihood and heroism. Let us not seek to conceal the fact that war, *biologically regarded,* means wastage and a reversal of eugenic or rational selection, since it prunes off a disproportionately large number of those whom the race can least afford to lose.

II. The Length and Breadth of the Struggle for Existence

Let us turn to another question, which concerns the struggle for existence. In spite of many protests, beginning with Darwin's, there is a widespread belief that Nature's message to man is: "Each for himself, and extinction take the hindmost," "contention is the vital force," careers are open to talons. There is indeed a measure of truth here, for we undoubtedly see much stern sifting in wild Nature, much redness of tooth and claw, extraordinary infantile and juvenile mortality, and, apart from parasitism, a ceaseless condemnation of the unlit lamp and the ungirt loin.

But when we look into matters more closely we find that we have not been careful enough either as regards Nature or Darwin's interpretation of it. For the struggle for existence, in and by which Nature

sifts, *i. e.,* eliminates discriminatively, includes much more than internecine competition between fellows of the same kith and kin. As Darwin said, the phrase is to be used "in a large and metaphorical sense, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny." It may be that the struggle is most severe between members of the same or nearly related species, though Darwin did not give many examples of this, but, in any case, we must not generalize the story of the black and brown rat into a theory of life. The struggle for existence is often manifested in an endeavor after well-being. It is the clash that occurs whenever organisms do in any way assert themselves against limitations and difficulties. The answers-back may be competitive or non-competitive, self-regarding or other-regarding, with teeth and claws, or with wits and kindness. In face of overwhelming difficulties and thwarting limitations, one creature sharpens its weapons, another thickens its armor, a third gives its offspring a better send-off on the journey of life, and a fourth makes some experiment in state-socialism. The modes of reaction are many, and one never to be forgotten is that evasive change of habit and habitat which we call parasitism—the door to which is always open. The struggle for existence includes all the endeavors of mate for mate, of parent for offspring, of kin for kin, as well as every degree of self-assertiveness from the young cuckoo ousting the rightful tenant of the nest to the cannibalism in the cradle that occurs in the egg-capsules of the whelk.

It is said, however, that in the long run what counts is that some members of a varying species are fitter for the conditions of life than their neighbors, and therefore survive. This is true, but the eliminating clash is not necessarily between the individuals, the pruning shears are often in the hands of the environment. The survivor in a plague-stricken family does not survive at the expense of his kin, nor compete with his kin; his phagocytes parry the microbe. In lining its nest with two thousand feathers the long-tailed tit unmistakably strengthens its own and its family's foothold in the struggle for existence, but its reaction to environing difficulties does not hurt any other tit.

Two other points should be noted. The mode of the struggle for existence is not always competitive, and the result of the struggle for existence is not always the discriminate elimination of the relatively less fit to the conditions. Sometimes all that we can discern is a thinning —not a sifting—and that does not in itself make for evolution. The only result of the struggle for existence that necessarily makes for evolution—progressive or retrogressive—is discriminate selection, where the survivors survive in virtue of the possession of a particular character —which may be better weapons, stronger armor, swifter feet, greater

material success, or a more developed capacity for obeying the law of the jungle.

The other point is this. Darwin attached great importance to the web of life, to the manifold and subtle inter-relations that bind creatures together in a vibrating *systema Naturæ*. One of the reasons for his emphasis was simply that he was so good a naturalist; the other reason was his discernment that survival in the struggle for existence is definitely related to the already established system of linkages, to all sorts of interdependences and solidarities. The texture of the web of life is so fine that even an apparently trivial new quality may be vital to the situation. For man this is of the utmost importance, that selection has a definite reference to the established system of relations. In other words, man does to a large extent make his own sieves.

A broad survey of the realm of organisms shows that a very large proportion of time and energy is given over to activities which are not greatly, if at all, to the advantage of the individual. Borne on by impulses and instincts as imperious as hunger and thirst, how many animals spend themselves for their race. It is their meat and drink to do so, and Nature takes advantage of their capacity for self-forgetfulness. In some types it seems almost extreme, as Cresson says:

> Everything for the species; everything through the individual; nothing for the individual.

In Goethe's words,

> Nature holds a couple of draughts from the cup of love to be fair payment for the pains of a lifetime.

The continuance of the race is often very costly or even fatal to the parent, and there is exhaustion of energies in securing the safety and sustenance of the young. It is a great fact of Organic Nature that while competitive individualism pays up to a certain point, survival and success are also to those types in which the individual has been more or less subordinated to the welfare of the species. Part of their fitness is in being capable of self-sacrifice. This is part of Nature's strategy which man has not adequately appreciated.

Thus we can not accept the caricature of Nature as in a state of universal Hobbesian warfare, each against all, and no discharge for any. That is only one aspect of the struggle for existence, and the subordination of the individual to the species is another. Especially among the finer forms of life do we find that the answer-back which is given to the environing limitations is less and less frequently an intensification of competition, is more and more frequently something subtler, some parental sacrifice, some cooperative device, some experiment in sociality. The improbability of war being the saving grace of human history grows upon us.

To sum up, man is not bound to follow Nature, but if he does he is not shut up to an imitation of that mode of the struggle for existence in which rats excel, namely internecine competition. And if he does pursue this method, as in war, he can not console himself with the belief that the result will be the survival of the fittest in any desirable sense.

III. War, Biologically Considered, a Reversion to the Crudest Form of the Struggle for Existence

We have considered the fact that serious sustained international war, considered biologically, implies a reversal of rational selection, and we have discussed a widespread misunderstanding due to a narrow conception of the struggle for existence. Let us pass for a little to the proposition that war, biologically regarded, is a return to the most primitive and crude form of the struggle for existence. Looking at this great war socially, we are, as a nation, practically unanimous in the resolution to resist to the uttermost an outrage on civilization, and to stand with our allies at all costs for freedom and justice; we are proud of those who are fighting, enduring, and dying for their country; we know publicly and privately of the virtues to which the war has afforded opportunity among combatants and non-combatants alike. But, admitting all this and more, can we deny that war, biologically regarded, is a return to the rat versus rat mode of the struggle for existence? No escape seems possible.

If this unpalatable fact be true why mention it, since after a certain, or rather uncertain, date in history this war was inevitable? We mention it because it behoves us to mingle fear with our pride. The implied reversion brings with it terrible risks, and when we hold up our hands at the frightfulnesses committed by our enemies, we should remember that we are not exempt from the risk of slipping down the rungs of the steep ladder of evolution. In the actual environment of war, as Mr. Theodore Chambers said in his admirable lecture on "Eugenics and the War," "the decent garments of custom are often torn off," and the Berserk discovered; and for those who are not fighting there is also, and less excusably, a tendency to reversion because of our necessary preoccupation with a struggle which, though embellished with the latest scientific devices and illumined with the finest heroism, involves a recrudescence of primitive passion. We may already see the deterioration in ungenerous and inaccurate depreciation of German culture, in unworthy scares, in unkindness to aliens, in suggestions of barbarous reprisals, and so forth. On the whole we are behaving well, yet it may not be amiss to remind ourselves of the solemn biological and psychological fact, that the past lives on in our present, with the risk of "Reversion ever dragging Evolution in the mud." What sowings

of dragons' teeth there must be in this terrible struggle; is it weakness to be afraid lest by and by, in the crop that springs from them, there be something worse than armed men?

IV. Some Practical Considerations

If the war is sifting out from the possible parent-stock of the future a larger proportion of those who are relatively more fit from an evolutionary or eugenic point of view, what is possible in the way of counteractive? Among the revaluations after the war may we not expect some change of public sentiment in regard to eugenic ideals, some more marked disapproval of selfish forms of celibacy, some more cordial encouragement of those desirable people who marry chivalrously while it is still springtime with them, without waiting till the bridegroom has secured twice the income his father had? There is patriotism in dying for our country; there is a conceivable patriotism in marrying for her and in bearing children for her.

It is to be hoped that one of the results of the terrible struggle in which we are engaged will be to direct more serious and widespread attention to the falling birthrate and the risks involved. We must insist on a discovery of the facts and causes of the decline in the British birthrate, and on a full discussion of the possibilities of checking the decline differentially. There is need for more plasticity in the ideal of "getting on," but it can hardly be regarded as a bad sign that there appears to be continual increase in the number of parents of good type who keep their families small because they do not wish their children —especially the girls—to run the risk of thwarted and unhappy lives. These risks have to be lessened, and that without making slackness feasible. In another connection we are all agreed that the lowering of the still far too high death-rate among healthy infants must continue.

As to the marriage of recruits, which has been a good deal discussed, other than biological considerations must be borne in mind, but the general eugenic position should be one of approval, if the ages are suitable, if the records are good, and if there is a certainty of adequate state-provision for the possible widows and children—the three large "ifs," it will be noticed.

If the wastage of war is brought vividly home to us by dramatic tragedies and irreparable losses, it may be that we shall be led as a nation to consider with increased seriousness and discernment other forms of vital wastage to which we tend to become blunted by familiarity. It should be interesting to inquire whether some of these, such as tuberculosis and alcoholism, are not, in part, at least, dysgenic in their sifting.

Galton hoped that in course of time eugenic principles would come to be dominant motives in the nation, but this is still far off. It is our

duty therefore to scan with careful criticism all practical proposals that may be hurriedly projected to meet crises of war strain. One instance may suffice. Unless the worst come to the worst, the nation should not consent to put children at the disposal of the farmer, for the effect of this would be to decrease the already too much restricted freedom of the child, and to depress still further the position of the agricultural laborer, for the needed improvement of which something would probably have been done ere now, had there not been war. Another danger, which may be mentioned, is that of permitting an interference with the liberty and dignity of women, which would not be tolerated in the case of men.

As eugenists we must resist in ourselves, and in all our organizations, the natural desire to economize in noble luxuries—in pictures and music, books and lectures, theaters and higher education. By all means let our criticism of consumption be intensified, but let it be enlightened. Let us prune our comforts before we pinch our souls. For apart from ourselves, who may be past praying for, economizing on the nobler luxuries means hardship and celibacy to those finer spirits who are the salt of the earth, whose virtue all must wish to see conserved in the natural inheritance of the race.

Without losing hold of the true idea and ideal of the state as a body politic—an organism—in which we all have our function, from cabinet ministers to road-members, we can not suppose that we are all equally irreplaceable. Indeed, the eye can not say unto the hand I have no need of thee, nor again, the head to the feet I have no need of you; but it will be agreed that true artists, for instance, are among the higher, less readily replaceable members of the community. There is no risk for us of there being too many of them. But there is great risk for them of there being too few of us to keep them and their art alive. The enforced economies of war imply lopping off super-necessaries; the danger is of crippling super-men. What has been said of artists applies also to the professions generally, and one recognizes the eugenic wisdom of the Professional Classes War Relief Council.

Those who have really learned the eugenic lesson are those who appreciate the organismal factor in evolution, who believe that the fundamental thing is the natural inheritance, bred in the bone. To those of this outlook it seldom seems promiseful to try to change by coercion what is intrinsic in the creature. The hopeful line is to make the most and the best of what we have, without tampering with that mainspring of life which is freedom. It is likely that we shall have many occasions for standing fast by this principle in the readjustments after the war. Attempts will be made to rush schemes which are non-eugenic in the sense of being coercive and incongruent with our racial temperament. One of these will be compulsory military training, of which

some wise men are advocates. It is probably less dangerous than a huge standing army, but it is full of risks. The mind takes color like the dyer's hand, and one fears that compulsory military training is one of the roots of militarism. It would be tragic to fall into the grip of one of the national diseases that we are combating in our enemies and to become insidiously Prussianized. Moreover the people of this country have an inherent dislike of coercion and do better without it. If a man does not demand our coat, we may perhaps give him our cloak; if he does not seek to compel us to go a mile, we may go twain without a grumble. Certain it is that in the time of revision it will be for the eugenist to champion the free and plastic organism rather than the highly efficient machine.

In recent years we have seen in this country a number of endeavors on a large scale towards the improvement of the conditions of human life. We have our detailed criticisms and honest doubts, but, on the whole, there is agreement that several things have been done, *e. g.*, in the way of Old-Age Pensions, which have greatly lightened the too prevalent "life-harming heaviness," and have relieved the national conscience at the same time. Other endeavors were in progress or incipient, which were more directly eugenic, in connection for instance with tuberculosis, and there was warrant for hoping that notable progress might be made along lines of practicable eugenics. Now there is the fear lest eugenic endeavors be put back for decades. Probably every one can already recall several progressive activities that have entered during the past six months into a state of encystation. For the undeniable privilege of being part of civilized Europe, and for the undeniable distinction of having been willing—on this occasion—to do the right thing at all costs, we shall have a long price to pay, and we shall be paying it long after the personal and ethical thrill has passed. Perhaps the deadliest part of the paying-up will be the shelving of eugenic endeavors and our connivance thereat.

The eugenic ideal is as old as mankind and older; it is the primeval pride in creation. But deliberate eugenics with the race as a whole in view is, with few exceptions, such as Plato's Republic and the Jewish people, relatively modern; indeed, Sir Francis Galton was the first to give it scientific expression. The newness of the idea of deliberate national eugenics, its remoteness from being instinctive, the rarity of the biological outlook, even among statesmen, make one apprehensive of the days of retrenchment. But this is not the time to bruit disappointment, and perhaps after all our fears may be liars.

Three hopeful considerations may be briefly referred to. (1) The war is likely to demonstrate the value of constitutions which can endure without stolidity, which have resiliency without "nerves." We may look forward to a heightening of the standard of all-round fitness.

There may also be a wholesome reaction from the two chief forms of national weakness, and an endeavor to improve the conditions which tend to increase these. All this will make for progress, as long as it is clearly recognized that veneering does not make bad wood sound. So far as improved nurture induces the fuller development of a good inheritance, or guards life from gratuitous infection or inhibition, or prevents the tare seeds in our inheritance from germinating, it is to be welcomed.

(2) In the second place this is a time of vivid national self-consciousness and of freshened idealism, and it is possible that the spiritual momentum of this may enable us to go ahead. It is just possible that we may be brought by the war nearer the idea and the actuality of a positive peace, of entering more fully into our kingdom. We must agree with Professor Patrick Geddes that the peace times we have known have often been more accurately states of latent war.

(3) A third consideration is also full of hope, that one of the almost certain results of the war will be an increased sense of solidarity among the various self-governing Dominions of the British Empire. We are going to know and to like one another better, having fought together, rejoiced and sorrowed together; we are going to see more of one another as distance-annihilating devices increase and cheapen. Perhaps we shall evolve a great confederate organization for the common tasks of peace. Is there not here a eugenic prospect of great interest, of larger experiments in out-breeding and in the influences of novel nurture? Perhaps we may discover in greater frequency of environmental and functional change, which is so potent in keeping the individual young, a possible source of variational stimuli, rejuvenating even the germ-plasm, which may be apt to get a little stodgy in one small island.

Perhaps we should not ever pass from a eugenic outlook without remembering that it is partial. In building a wall the mason uses plumb-line, level, and square, and so we have to employ other criteria besides that of the conservation and evolution of life. As eugenists we are concerned with the natural inheritance and its nurture, which is fundamental, as men we are also concerned with our social heritage, which is supreme. The social organizations and institutions in whose life we share, the traditions of honor, veracity and justice, the treasures of literature and art, memories, such as we honor to-night, which ever beckon us to follow after valor and understanding—these and much more form our social heritage, to be wrought for and fought for as keenly as the embodied health of the race. We cannot end without expressing the hope that even if the natural inheritance of our race must suffer impoverishment through the tragic sifting of this most terrible war, we shall win through in the end with our social heritage enriched.

BARBARISM, CULTURE, EMPIRE, UNION

By Dr. BENJAMIN IVES GILMAN

BOSTON MUSEUM OF FINE ARTS

THE word "barbarism" voices the contempt of the Greeks for the peoples of other speech about them. Barbarian (*βάρβαρος*) is one of the words called onomatopoetic, whose sense is in its sound. It sounds like mere mouthing, and "bellower" or "inarticulate speaker" is its original sense. A barbarian meant to the Greeks one denied the main channel of human sympathy—the gift of comprehensible utterance. His language is pure babble. The word traces the undeveloped manners, customs, polity, trade, craftsmanship, art, science, religion, of rude communities back to mutual misunderstanding among their members. They are barbarians because unable to take each other's point of view. A custom is barbarous when it can not be followed without offending the sensibilities of others. A punishment is barbarous when its anguish to the victim would stay the executioner's hand were he really alive to it. Mr. Chesterton has just told us that the barbarian is he who "lacks that little mirror in the mind in which we see the mind of the other man"; or, to vary the phrase, "in which we see what the other man has a mind to."

The opposite of barbarism we call culture. Culture is the reflection within my mind of what my neighbor has a mind to. We owe the word to the Latins, who applied their term for "care" or "tillage" to that mellowed condition of the mental soil in which we come to feel things as other men have felt them. The culture of an individual is the whole body of the ideals he has absorbed from others. The culture of a nation, race or period is the sum and substance of the ideals transmitted from one individual to another until they have become the common property of all within its limits. It is in this collective sense that we speak of Swedish culture, Latin culture, the culture of the Renaissance. Civilization implies culture. The multiplication of common observances, common achievements, is impossible without mutual understanding, without tastes and aspirations shared. A civilization is a precipitate of all the ideals current among its citizens.

High civilization tends to confirm what it leaves of man's native barbarism. The argument "Our ways are good; therefore no other ways are worth notice" is a non-sequitur dear to the human mind. The legendary order of Caliph Omar for the destruction of the Alexandrian Library bespoke culture and barbarism at once: "If these books con-

firm the Koran, they need not be preserved; if they oppose the Koran, they should not be preserved." The Greeks called Egyptians, Latins, Hebrews, Hindus, alike barbarians, and disclosed their own barbarism in so doing. The Jews were to Jews the chosen people of God. To the Chinese the Chinese alone are Celestials. To us of the United States our own land alone is God's country. The possession of these lofty and complex ideals but emphasizes the inability of their possessors to transcend them.

Barbarism may be either naïve or conscious. Incapacity to share in the desires of others may be betrayed either by ignoring them or by aiming to thwart them. We associate the attitude of indifference with the lower animals, and call it brutal; the attitude of frowardness with evil spirits, and call it devilish. The one betokens vacuity of mind, the other perversity of heart.

Beyond both indifference and frowardness, but barbaric like both, stands the spirit of empire; the impulse to impose my will, irrespective of what I will, upon others, irrespective of what they will. This attitude of mind is barbaric, for it reveals my inability to take to heart what others have at heart; but it is more than brutal barbarism, for it takes the wills of others into account; and it is more also than devilish barbarism, for it builds my own will as well as destroys theirs. It is neither dumb, like animal selfishness, nor is it outspoken in the words of Mephistopheles: "I am the spirit that denies;" but in the words of Napoleon: "I was born to bend the wills of other men to mine." The instinct of empire is a social attitude in its external recognition of others; it is unsocial, in failing to make that recognition an inward fact.

Such an external recognition of another's purposes is compatible, be it said, with unlimited instruction concerning them. For all intellectual apprehension of taste is knowledge about it; we must feel in order to know taste itself. The external attitude is even fostered by instruction; since knowing so much we may easily fancy we know all. We become pedants of culture, mistaking its cognitive shell for its sensitive kernel. However rich our information concerning the ideals of another, unless in some degree we share them, our culture as far as he is concerned is nil. Looking on without taking part, perceiving without experiencing, we remain essentially barbarian.

Culture, the actual assimilation of the ideals of other people, replaces the spirit of empire by a spirit which may be called that of union. The spirit of empire is a simple intention, namely, the establishment of my will, because mine, in place of other wills, because other than mine. The spirit of union proves to contain a triple intention. The penetration of another mind has three effects upon mine: the awakening of certain desires of the other in me, the missing of

certain of my desires in him, and the recognition of a conflict between certain of my desires and certain of his. The spirit of union thus engenders three purposes: a purpose to partake in admirations, a purpose to impart them, a purpose to reconcile them. Were two minds in perfect union, each would be leader in the pursuit of its own independent purposes, each a cordial second to the independent purposes of the other, and each ready to settle their conflicts of purpose by any means which a sympathetic understanding of the purposes of the other would sanction, and only by such means. So a Christian and a Buddhist, had each a sympathetic grasp of the other's faith, might seek, the one to give, the other to receive, that joy in the Lord which Buddhism has lacked, and that interest in the fate of the whole animate creation which historical Christianity has lacked. So Russia, China and Mongolia, were the mind of each open to the mind of the others—a supposition still extravagant between any peoples—might weigh between them the question whether in the interest of all three Mongolia should remain under Chinese suzerainty, accept Russian rule, or become autonomous.

The spirit of union does not exclude the possibility that the end of a discussion between the parties may be disagreement, and change them from co-workers into opponents. But opponents each responsive to the interests of the other would fight, not for their own interests solely, but for what each believed to be the interests of both. This alone is righteous war. The saying of Benjamin Franklin: "There never was a good war or a bad peace"—was a pardonable exaggeration; but we make it a falsehood when we interpret it to mean that there never can be a good war or a bad peace. The spirit of union, which is the spirit of good will, aims at peace, but only in the interest of all; and may inexorably demand war, also in the interest of all.

To the lasting honor of this nation, the United States have been the first to enter into treaties embodying this third requisite of cultivated relations with other peoples. However infrequent the use of such machinery of discussion in advance of war, it will not rust ingloriously, for it is made of a metal that rust can not corrupt. No other machinery, thanks to man's inventiveness, is needed to-day by the spirit of union. The freedom of intercourse between nations of the modern world in itself provides for the satisfaction of the two other impulses which make up the spirit of union—the impulse to offer to others our share, and to gain from them their share in the world's ideals.

To which of these two spirits—empire, or union—does the future belong? To the spirit of union, for a reason partly psychological and partly mathematical. Conquests unite the conquered against the conqueror; and combinations tend to be stronger than individuals. Minds being what they are and numbers being what they are, a man is apt

to avail more through his friends than through his own right arm. The clasp of the hand will outlive the blow; for there is the strength of two behind every grasp, and of but one behind any blow that evokes it.

A play on French words may serve to fix in mind the necessary evanescence of empire. We may fancy that the word derives from the verb *empirer*, signifying to deteriorate. By this burlesque etymology its root-meaning comes to be that of going from bad to worse; and an empire becomes accordingly that form of international organization which is foredoomed to decline and fall.

Even the short span of years which recorded history has yet covered brings ample evidence in support of this definition. Either external coalitions to overthrow them or internal coalitions to reject their yoke have ended, or threaten to end, nearly every known empire. The British Empire which still stands and even shows signs of permanence, has learned the lesson of union, and bids fair to become an empire in its name alone. British imperialism was once, as Professor Cramb has told us, the will to give all men under British sway an English mind, in the spirit of the boast of Alexander the Great: "I will make all men Hellenes." But the instruction of England in the larger art of government, begun in North America, has been continued since, and her imperial aim is fast becoming a will to live with other men and let them live. The British Empire, if it last, will one day be what the Seven Seas choose to make of it, not what England alone chooses to make of it. The Irish mind, the Boer mind, the Hindu mind, will share with others in the process. The United States have of late been tempted to forget the lesson they themselves taught; but Cuba, Mexico and the Philippines stand as witnesses that for all our growth in power, we still hold fast to the doctrines of our Declaration of Independence. With a giant's strength we have twice and even thrice refused to use it like a giant. Born a Union, we are engaged in laying the foundations of other unions. It is possible to conceive of but one more august political structure than these—one in which every sovereign people in the world should contribute each its own mind to a union which should ensure the perpetual development of the minds of all.

The conclusion of the whole matter may be put into modern American. Empire is the child of the barbarism out of which the world tends; culture the parent of the union into which the world tends. There is no middle term; for it is always barbarism to claim "I am It"; and culture always answers: "There are others."

MEASURING HEAT FROM STARS

By Dr. W. W. COBLENTZ

I. Some Questions Answered

IF the title of this paper had been chosen as, "Measuring Heat from Stars—Of What Practical Use Is It Anyway?" it would express the feeling of the average interviewer. The question is not meant to be contemptuous. It is the expression of the mind that figures everything on the basis of an immediate return upon his investment.

The interrogator may be one "engaged in writing an article for some magazine" and he must needs "tell the layman the practical side of the subject." Suppose I, in turn, ask my interrogator the question: "Of what prospective use was your layman when he was in the first stages of development?" Said interrogator shrugs his shoulders, smiles, and admits that perhaps the "layman" is not the only one to be considered; that some of the results of investigations must go into the great storehouse of knowledge, no one knowing what their ultimate use may be; that the great unknown can be explored only step by step; that each achievement may be only one more link in the chain of knowledge, perhaps to be disputed and refuted by some future investigator or perhaps be put to some practical use of some future "layman."

Another question raised is, "Why the Government should be measuring the heat of stars?" not realizing that such activities are incidental, conducted to assist, if possible, its citizens in every possible way. The narrow-gauge college professor may perhaps take it as an intrusion upon his field. To such an one the writer can but tell the lesson taught him some months ago, when one bright morning, on walking through the woods, a loud commotion was heard in the topmost branches of a tall oak tree. Two wood-peewees were quarreling for the possession of this tree—as a place to catch flies! There were hundreds of other trees close by, then why quarrel about this one. How like the scientific man, I thought. We quarrel for fields of research, just as though the heavens were not ablaze with objects for investigation.

A further question asked by the interrogator is, "Well, how do you measure the *temperature* of the stars?" This question may be easily dismissed by saying that we can not measure the temperature of the stars. The best we can do is to attempt to measure the rate at which they are losing heat. But until the past summer even this attempt was of little interest to the astronomer. Heretofore experimenters were glad to be able to record heat from a few of the brightest stars; let alone attempting to measure stars of the 6.7th magnitude which are about

1/480th as bright. This is not saying that previous attempts were of no avail; for they were the stepping stones which aided in what small success was attained with the Crossley reflector on Mt. Hamilton, this past August. If, then, the "layman" with his question of the practical side will please wait a little while longer, and in the meantime consider that the present work is simply another stepping stone in the path of conquest of the secrets held in the firmament, it will greatly help the investigators who are not concerned with the immediate commercialization of everything in and under the heavens.

II. A Brief Summary of Previous Attempts at Measuring Stellar Radiation

The measurement of stellar radiation has been attemptel by three methods: (1) by means of thermoelements, (2) by means of a Nichols radiometer, and (3) by means of a selenium cell.

Among the earliest attempts by means of thermoelements are the measurements of Huggins.[2] He used one or two pairs of elements of bismuth-antimony in the focus of a refractor having an aperture eight inches in diameter. He recorded positive deflections for *Sirius, Pollux, Regulus,* and *Arcturus.* The data given are very meager. It required from four to five minutes (fifteen minutes in one record) to obtain a reading.

Thermoelectric measurements of the radiation from *Arcturus* and *Vega* were made by Stone[3] who used a refractor 12.75 inches in diameter. In spite of the excessively long time (about ten minutes) required to obtain a reading he appears to have obtained fairly reliable results. His measurements show that *Arcturus* emits more radiation than does *Vega;* his numerical measurements for June 25, 1869, being *Arcturus: Vega* = 3 : 2. Considering the fact that the infrared radiations from *Arcturus* suffer greater absorption than those of *Vega* in passing through an air mass highly saturated with water vapor, and in passing through the glass lenses of the refractor this ratio (3/2) is in close agreement with subsequent measurements using a reflecting telescope.

Recent measurements of stellar radiation were made by Pfund,[4] using thermoelements in an evacuated receptacle. The receivers attached to the junctions of the bismuth alloys (BiSn—BiSb) were about 1.2 mm. in diameter. The sensitivity was such that the radiation from a Hefner lamp at a distance of 1 m. gave a deflection of 2400 mm. He used a reflecting telescope thirty inches in diameter, and made measurements on *Vega* (7.5 mm. deflection), *Jupiter* (part of disk; 3 mm.), and *Altair* (2.0 mm. deflection, sky hazy). The ratio of the radiations

[2] Huggins, *Proc. Roy. Soc.*, 17, p. 309, 1868–9.

[3] Stone, *Proc. Roy. Soc.*, 18, 159, 1869–70.

[4] Pfund, *Publ. Allegheny Obs.*, 3, p. 43, 1913.

Vega:Altair$=3:7$, which is at variance with the results obtained on Mt. Hamilton, and emphasizes the importance of making observations through an atmosphere free from water vapor. He concluded that with a more sensitive galvanometer and one of the largest reflectors it would be possible to observe stars to the fourth magnitude.

An extensive series of measurements of the radiation from *Arcturus, Vega, Jupiter* and *Saturn* were made by Nichols[5] by means of his radiometer, which, like the thermopile, absorbs all the radiations of all wave-lengths falling upon it. The receivers were 2 mm. in diameter. A candle at a distance of 1 m. would have given a deflection of 724 mm. He used a two-foot reflector and observed deflections of 1 to 2 mm. The sensitivity of his radiometer was such that a deflection of 1 mm. would be caused by 1/68,750,000 of the heat received on a surface equal to the aperture of the concave mirror from a candle at 1 meter distant. Or, neglecting atmospheric absorption, the sensitivity was such that by using the two-foot mirror to focus an image of the flame upon the radiometer, he would have obtained a deflection of 1 mm. from the candle placed at a distance of 5 miles. He concluded that the thermal intensity was *Vega:Arcturus:Jupiter:Saturn*$=1:2.2:4.7:0.74$. As for the possibility of further work he concluded that by using a five-foot reflector it would be possible to observe white stars down to the second magnitude and red stars possibly to the third magnitude.

The Boys[6] radiomicrometer has also been tried in measuring radiation from stars. The instrument was used with a sixteen-inch reflecting telescope. The slight deflections obtained on various planets and stars were regarded as of questionable origin.

The earliest measurements of the light from stars by means of a selenium cell were made by Minchin,[7] who used a 2-foot reflector. He examined about a dozen stars, some being as small as the third magnitude. Owing to the peculiar properties of the selenium cell, which is highly selective in its response to radiations of different wave-lengths, the data can not be used in comparing the radiation from different stars. The selenium cell can be applied, however, in the measurement of the maximum and minimum of light emission from a variable star which does not change in color. For this purpose it has been used by Stebbins[8] in connection with a 12-inch refractor.

III. A Brief Account of the Present Measurements of Stellar Radiation.

The telescope used in the present investigation was the well known Crossley Reflector which is part of the equipment of the Lick Observa-

[5] Nichols, *Astrophys. Jr.*, 13, p. 101, 1901.

[6] Boys, *Proc. Roy. Soc.*, 47, p. 480, 1890.

[7] Minchin, *Proc. Roy. Soc.*, 58, p. 142, 1895; 59, p. 231, 1896.

[8] Stebbins, *Astrophys. Jour.*, 32, 185, 1910; 33, 385, 1911.

tory at Mt. Hamilton, California. The reflecting mirror is three feet in diameter. The altitude of the station is a little over 4,000 feet. The summer months being rainless; there being no fog or dew; the night temperature being only a few degrees lower than the day time—these were items which made it possible to have fairly uniform conditions on different nights.

The radiometers used in these measurements were minute thermocouples with receivers 0.3 to 0.4 millimeter in diameter; *i. e.,* about as large as the punctuation mark at the end of this sentence. These thermocouples, the elements of which were bismuth and platinum, were mounted in glass receptacles. as shown in Fig. 1, from which the air could be evacuated. The vacuum was then maintained by occasionally heating metallic calcium, *Ca*, contained in a quartz-glass tube shown in Fig. 1. Metallic calcium has the property of absorbing atmospheric

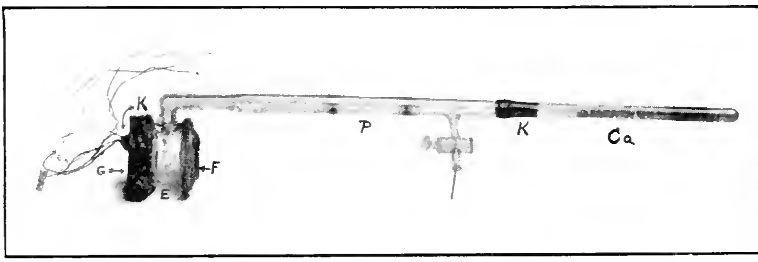

Fig. 1. Showing the Glass Receptacle which Contains the Thermocouples, *E*, and the Calcium *Ca* Used to Maintain a Vacuum.

gases when warmed to a low red heat. This glass receptacle was then mounted in a brass box as shown in Fig. 2, which was made especially to take the place of the plate-holder in the camera which is part of the equipment of the telescope. By removing the screws *S, S,* it was therefore a matter of only a few minutes to dismount this radiometric outfit and substitute the plate-holder. In this manner part of the night was spent in making radiometric measurements on stars, after which the telescope was surrendered to another observer who was photographing a newly discovered satellite of Jupiter.

Referring to Fig. 1, it may be added that the star light after reflection from the telescope mirror passes through a fluorite window, *F,* and is brought to focus upon the receiver, *E,* of the thermocouple where the rays are absorbed thus heating the thermojunction. This extremely minute amount of heat is sufficient to warm the thermojunction a few hundred-thousandths of a degree and thus generate an electric current which passes through the coils of a miniature tangent galvanometer, shown in Fig. 3. Unfortunately one sees nothing of these coils of wire which are imbedded in two blocks of Swedish iron.

Because of its high magnetic permeability, iron is used to shield the suspended system of magnets from variations in the magnetic field, such as produced by passing street cars, etc. This galvanometer is very sensitive, so that it responds to a current of less than one ten-billionth

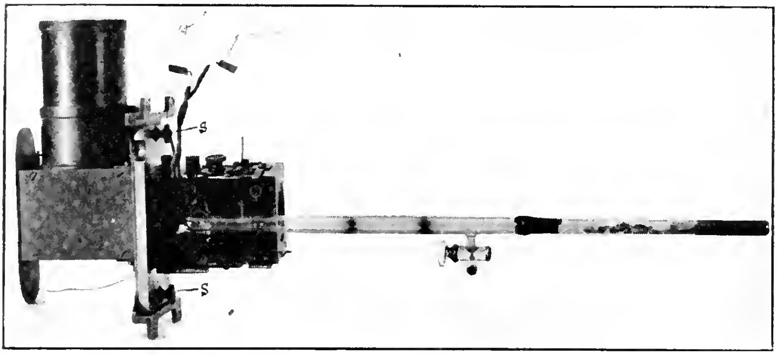

FIG. 2. SHOWING THE GLASS RECEPTACLE OF FIG. 1 MOUNTED BY MEANS OF THE SCREWS S, S, IN THE PLATEHOLDER OF THE CROSSLEY REFLECTOR.

of an ampere, and in observing the heating effect produced by different stars, measurements could be made in four to five seconds.

This outfit consisting of an ironclad galvanometer and two receptacles containing the thermocouples was constructed in Washington, D. C., and carried to Mt. Hamilton, Calif., a distance of over 3,200 miles without serious mishap (one thermocouple was broken in climbing the mountain). A vacuum pump was shipped, but it was not unpacked. The slight vapors given off from the cement and stop-cock grease were removed from these receptables by occasionally heating the calcium by means of a small alcohol blast lamp. From this it is evident that one of the principal achievements was in demonstrating that with an equipment of several thermoelements, mounted in evacuated receptacles, one can go to the remotest station for radiation measurements, without taking an expensive or cumbersome vacuum pump.

After observing for several nights it was found that red stars emitted far more radiation than do the blue ones having the same photometric brightness, and attention was given mainly to the solution of this question. Accordingly stars were selected having the same visual magnitude, but differing in color; and which were close together in right ascension and zenith distance, in order to obtain the measurements of the ways traversing the same air mass. In passing through our atmosphere, the radiations from the red stars suffer a greater absorption than do the blue stars. For this reason it was desirable to eliminate, as much as was possible, the effect of air mass.

As the work progressed, it became a rather instinctive feeling to

avoid the blue stars of less than the fourth magnitude, owing to the difficulty in measuring their radiations. However it was found possible to measure the heating effect of red stars down to the 6.7 magnitude.

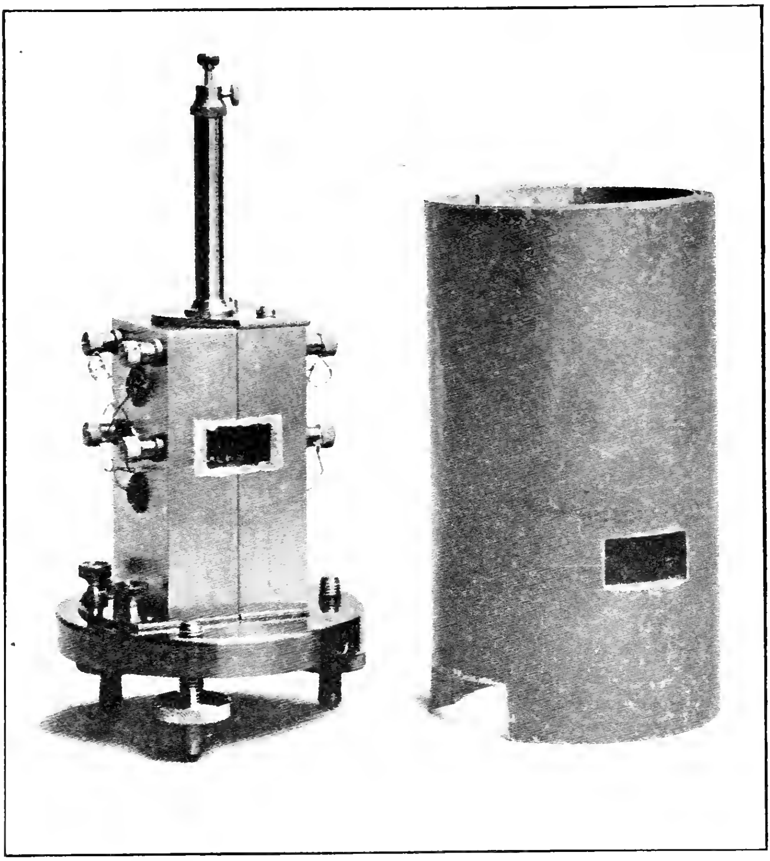

FIG. 3. IRONCLAD THOMSON GALVANOMETER USED IN MEASURING THE ELECTRIC CURRENT GENERATED BY THE THERMOCOUPLES. One of the iron shields is shown to the right.

If it had been merely an attempt to show the possibilities of the instruments, then by selecting red stars, and by increasing the galvanometer sensitivity, positive indications could have been obtained of radiation from stars of the eighth to ninth magnitude. That, however, would have been simply a spectacular achievement, to awe the layman, and under the present conditions of observation, could not contribute much to science.

The aim was to do one thing thoroughly, rather than to attempt a varied program. This one thing was the establishment beyond all reasonable doubt, by two distinct methods, that the red stars as a

class emit a far greater amount of total radiation than do the blue stars; that they have a higher emissivity, or, in other words, that they are cooling faster than the blue stars. (In parenthesis it may be added that it is doubtful whether the interior of a red star is cooler than a blue star. The whole mass is no doubt shrinking and the temperature may be actually rising. But the idea to be conveyed is that in the various stages of stellar evolution, the "red star stage" seems to be the one in which a star is "burning out" the fastest.) The first method, viz., measuring the total radiation from red and blue stars having the same photometric brightness, as already mentioned, is somewhat uncertain, because the radiation received from a star is a function of its size, distance, temperature and especially its emissive power. Some of the largest stars are no doubt the farthest from us. The second method of observation consisted in roughly separating the star's rays into a spectrum, by means of an absorption cell of water which absorbs most of the infra-red rays and transmits the visible rays. Hence, by measuring the total radiation from a star, and also the part which is transmitted by the absorption cell of water we obtain an estimate of the relative amounts of energy in these two parts of the spectrum. This measurement is a ratio of two quantities of energy; and hence is independent of the size, the distance and the temperature of the star. It gives us direct information of the emissivity of the different parts of the star's spectrum. It is true that it gives us information of only two parts of the spectrum; but, from our knowledge of the solar spectrum, and of the spectra of terrestrial substances, this information enables us to make important deductions as regards the distribution of energy in the spectra of stars.

TABLE I

Object	Magnitude	Deflection	Type	Object	Magnitude	Deflection	Type
β Orionis	0.34	2.50[1]	*B*8 p.	19 Piscium	5.30	0.46	*N*
α Orionis	0.92	22.4	*Ma*	γ Aquarii	3.97	0.24	*A*
θ² Tauri	3.62	0.18	*A*5	λ Aquarii	3.84	1.02	*Ma*
ε Tauri	3.63	0.35	*K*	δ Capricorni	2.98	0.28	*A*5
ν Tauri	3.94	0.12	*A*	β Aquarii	3.07	0.55	*G*
γ Tauri	3.86	0.36	*G*	β Ophiuchi	2.94	0.37	*K*
δ Tauri	3.93	0.52	*K*	δ Ophiuchi	3.03	1.37	*Ma*
α Auriga	0.21	6.14	*G*	α Coronæ Borealis	2.32	0.48	*A*
α Tauri	1.06	6.78	*K*5	γ Draconis	2.42	1.59	*K*5
		6.84		β Ursæ Majoris	2.44	0.37	*A*
δ Ceti	4.04	0.08	*B*2	γ Draconis	2.42	1.58	*K*5
υ Ceti	4.18	0.31	*Ma*			1.67	
φ Pegasi	5.23	0.22	*Ma*			1.64	

Some of the data obtained by measuring the total radiation from blue and from red stars, having the same brightness, will now be discussed. It was possible to make quantitative measurements on stars

[1] Galv. Sensitivity $i = 1 \times 10^{-10}$ Amp.

down to the 5.3 magnitude. It is to be remembered, in considering this data, that a star of say the second magnitude is only $1/2.5$ as bright as a star of the first magnitude, *i. e.,* one magnitude differs from another by the factor 2.5 in brightness. However the total radiation may be entirely different as may be noticed in Table I. In this table the last column gives the spectral classification used by astronomers. The blue stars have the classification *B, A.* These stars pass into the yellow gradation *F, G, K,* the latter being yellowish-red. The red stars are Class *M* and the deep red ones are Class *N.* Keeping in mind this classification, it may be noticed that the red star *α Orionis* emits about eight times as much total radiation as the blue star, *β Orionis,* which is much brighter to the eye. A similar example is the yellow star *α Auriga* (Capella) and the beautiful red star, *α Tauri* (Aldebaran), both of which stars are familiar objects. The latter is only about one-half as bright to the eye; and yet it emits the same amount of total radiation as does the brighter star. Comparing stars of the same photometric brightness the 5.3-magnitude stars *φ Pegasi* and *19 Piscium* are interesting examples because of their smallness, and because the latter is of a deep red color. The latter follows the general rule that the redder the star the greater the amount of total radiation received. The number of these very red stars is very small and they were not conveniently situated for observation. However from the observations on numerous stars of *Class M* as compared with blue and yellow stars of the same photometric magnitude, it is to be expected that these very red stars, *Class N,* will be found to have, as a general rule, the highest emissivity of all. Among all the data collected, on 105 stars, there are no exceptions to the general classification, viz., the redder the star the greater the amount of total radiation emitted. To some, of course, this information is not unexpected. However, if the reader will pause for a moment and consider that some of these measurements were made on starlight which left its source more than 160 years ago, and that stellar distances are so inconceivably great that another 160 years must elapse before the arrival of starlight which is being emitted at the present moment, it will be evident that every measurement has a value of far greater importance than merely confirming our expectations which are based upon our preconceived notions of what is occurring on a star and in passing through interstellar space.

The second method of studying the quality of the radiations of red and of blue stars, by means of the absorption cell of water, is more limited in range, because of the weakness of the radiations received. Only a few stars could therefore be investigated by this method. From the first method of observation it is to be expected that the total radiation from a red star contains more infra-red rays than does the total radiation from a blue star, and hence the amount transmitted by the

TABLE II

TRANSMISSION OF STELLAR RADIAITION THROUGH A 1 CM. LAYER OF WATER

Object	Stellar Class	Transmission in Per Cent.	Remarks
		Blue Stars	
α Lyræ	*A*	58	(Vega)
α Aquilæ	*A5*	69	(Altair)
β Orionis	*B8* p.	42	(Rigel) A low value for a blue star
		Yellow Stars	
α Auriga	*G*	48	(Capella)
α Boötis	*K*	45	(Arcturus)
α Tauri	*K5*	35	(Aldebaran)
γ Draconis	*K5*	32	
		Red Stars	
β Pegasi	*Mb*	29	
α Orionis	*Ma*	27	(Betelgeux)
α Scorpii	*Ma* p.	27	(Antares)
α Herculis	*Mb*	21	
Jupiter		65	Receiver in center of disk including part of dark band.
		66	Receiver covers upper dark band.
Venus		59	
Saturn		55	Receiver covers central disk.
Moon		14.7	

water cell will be less for the red star, *Class M*, than for the yellow star, *Class F, G, K*, and a blue star, *Class B, A*. This is the true condition of affairs, as may be noticed in Table II., which gives the percentage of the total energy falling upon the thermocouple, which is transmitted by the water-cell, for blue, yellow and red stars. From this table it may be seen that as much as 60 per cent. of all the radiations coming from a blue star lies in the spectral region to which the eye is sensitive, while only from 20 to 30 per cent. of the total radiation received from a red star affects the eye and the photographic plate. This brings out very clearly why it is that a red star of the same visual brightness as a blue star (causes a larger galvanometer deflection) emits from two to three times as much total radiation. It means that from 70 to 80 per cent. of the radiation from a red star lies in the infra-red—beyond the spectral region to which our eyes are sensitive.

The absorption cell tells us nothing of the size or the distance of the star. It indicates that the shape of the spectral energy curve of the star is such that only about one fourth of the total energy emitted by a red star lies in the visible and in the ultraviolet part of the spectrum. However, it should dispel all doubt as to the quality of the radiations emitted by red and by blue stars. The absorption does more than merely tell us the region of the spectrum in which the most energy is distributed. It may prove useful in detecting dark companions of

star systems. There are no doubt many blue and yellow stars having companions which have become so cool and nonluminous that their presence can not be detected photographically. To the eye the star will appear to be blue or yellow. A good illustration is the ordinary paraffin candle. To the eye it looks yellow, because the red-hot wick contributes but little to the total luminous output. But the red-hot wick is very rich in infra-red radiations, as compared with the luminous flame, and when measured with a thermopile (or some other similar radiometer), and an absorption cell, it is found that the red-hot wick contributes materially to the total energy radiated from the flame. In a similar manner a red-hot star will contribute materially to the total radiation from a star system which appears to be blue. The conspicuous star β *Orionis* (Rigel) is an excellent illustration. Astronomers have classified it "*B S p*" the letter "*p*" meaning that it has a peculiar spectrum. Whether this peculiarity is sufficiently definite to indicate that there is a companion star, the writer does not know. However, the writer's radiometric classification, Table II., would place it with the yellowish-red stars having a transmission of some 40 per cent. through the absorption cell, instead of with the blue stars. No doubt this star has a dark companion which has thus far escaped detection.

An excellent example which the writer desired to study, but was prevented owing to the fact that at that time (August, 1914) the star does not rise before dawn, is *Sirius*. This star has a companion which has become so cool that it is rated as a tenth-magnitude star. Although the presence of a companion star was suspected, the light coming from it is so weak that in the presence of the bright star (Sirius), for some years, it defied detection. This companion star is of enormous size, being one half as massive as the bright component: but it sends out only 1/30,000 as much light. It would have been very interesting to determine what amount of radiation from this star system is transmitted through the water cell.

Two stars having 5th magnitude companions were studied, viz., β *Pegasi* and α *Herculis*. Both stars appeared to have an excessive amount of total radiation in comparison with their photometric brightness. In the case of α *Herculis* the companion star caused a deflection of almost a centimeter on the galvanometer scale. In Table II. it will be noticed that this star has the lowest transmission through the water cell. No doubt this is attributable to the large amount of infra-red radiations contributed by the companion star, which caused galvanometer deflections about 1/5 those obtained from the bright component.

Attention has already been called to the fact that the receiver, which was attached to the thermojunction, was very small. It was therefore possible to measure the radiations from different parts of the surface of

a planet. One of the most interesting series of measurements was made on the light reflected from the bright and the dark bands of *Jupiter*. Both gave practically the same transmission through the water cell, showing that whatever may be the cause of these dark bands, the diminution in brightness is quite non-selective as regards the infra-red. Interesting measurements were made on *Saturn* and its rings. Measurements on a planetary nebula showed no positive indications of radiations from it. However, from the observations on blue and red stars, it was not expected that definite indications would be obtained of radiations from a nebula.

In marked contrast with *Venus, Jupiter* and *Saturn,* only about 15 per cent. of the light reflected from the Moon is transmitted by the water cell. This is attributable to the fact that the Moon having no atmosphere, the surface becomes warm from exposure to the Sun's rays, and in turn radiates heat waves, which are not transmitted by the absorption cell of water.

In view of the fact that, heretofore, observers were glad to obtain any indication of the radiation from stars and planets, it is of interest to record that in observing the radiation from *Venus* it was necessary to place a resistance of 50 ohms in series with the galvanometer in order to reduce the sensitivity and thus keep the galvanometer deflection (which amounted to 127 cm.) upon the scale.

IV. The Absolute Value of the Total Radiation from the Stars

It is of interest to obtain a rough estimate of the total amount of heat received from a star as compared with the heat received from the sun, which is of the order of 1.9 gram calories per square centimeter per minute. This was accomplished by standardizing the thermocouples and galvanometer in terms of radiant power. In this way it was determined that the amount of starlight which caused a deflection of 1 mm. $= 34 \times 10^{-14}$ gram calorie per sq. cm. per minute. Or it would take 100,000,000,000,000/34 minutes, *i. e.,* six million years to raise the temperature of 1 gram of water 1° C. The star *Polaris* is an excellent example. It produced a galvanometer deflection of 6 mm. Hence it would require only one sixth as long to raise the temperature of 1 gram of water 1° C. In other words, assuming that, in the meantime, all the incoming radiations are absorbed and that no heat is lost by conduction, convection or radiation, then it will require the radiations from *Polaris* to fall upon 1 square centimeter continuously for one million years in order to raise the temperature of 1 gram of water 1° C. In marked contrast with this value, the radiation from the sun which is transmitted by our atmosphere and falls upon an area of 1 sq. cm. of the earth's surface is sufficient to raise the temperature of 1 gram of water 1° C. in about one minute. Moreover, the total radiation

from all the stars which at any moment can fall upon 1 sq. cm. of the earth's surface is so small that it would have to be absorbed and conserved continuously for a period of 100 to 200 years in order to raise the temperature of 1 gram of water 1 degree centigrade. Evidently the incoming stellar radiation can contribute but little in retarding the cooling of the earth. For the measurements of nocturnal radiation, which is usually a loss of terrestrial radiation into space, indicate that for a lampblack surface the outgoing radiation may be as high as 0.1 the incoming solar radiation. The emissivity of the materials forming the earth's surface may be much lower than this value. Nevertheless, it is much greater than can be compensated for by a continuous incoming of stellar radiation. The temperature of the earth must therefore ultimately tend towards the absolute zero of temperature.

V. Some Astroradiometric Problems that Await Solution

A complete statement can not be made of the problems in stellar radiation that require investigation. They stare one in the face whichever way one turns. Realizing the inadequacy of the radiometric apparatus now available one must sit with eyes closed in order not to become impatient with existing conditions, both as regards the production of radiometric apparatus sufficiently sensitive to make the measurements and as regards financial assistance which is necessary to carry on the work. It is not a work that can be "cleaned up" in a season. It will require years of painful, nerve-racking toil in order to accomplish anything of worth.

While it is hoped that the present investigation will make available to the astronomer one more instrument for the investigation of celestial objects, it is desirable to emphasize that, from the insensitive nature of the instrument, the astronomical application can not be very wide as compared with the spectrograph. However, its physical properties are such that, in a limited field, it can be employed in attempting the solution of some of the most fundamental questions in astrophysics. Take for example the question of the emissivity of blue stars as compared with red stars. The general conclusion appears to be that blue stars are at a higher temperature than red stars, and that the emissivity of the red stars is higher than that of the blue stars. The higher emissivity of the red stars would be attributable to a marked change in the distribution of energy in the spectrum, brought about by a change in the physical condition of the stellar surface.

With the rather insensitive radiometric outfit used in the present investigation it was shown that the total radiation received from a red star is two to three times that of a blue star of the same photometric brightness. These observations should be extended. Another field of astroradiometric research is the measurement of the radiation from

variable stars, especially those which undergo a change in color. A general radiometric survey of the stars is desirable; especially of star systems which may have companions which are too dark to detect photographically. The bright components of these stars would give an excess of total radiation as compared with other stars of the same color and having the same photometric brightness. Two stars apparently giving such an excess of total radiation were found in this preliminary survey and no doubt many other examples will be found.

It is possible that measurements of the total radiation from stars may be of assistance in answering the question whether light is absorbed in traversing interstellar space. When one considers that the measurements, made last August, on the radiations from *Polaris* (the pole star) were vibrations which were emitted forty-seven years ago, and that the radiations from the *Orion* group of stars started on their journey through space 160 years ago, the distances involved are so inconceivable that one naturally wonders how it can be possible that there is not sufficient "cosmic dust" in interstellar space to scatter and thus diminish the visible radiations to a greater extent than the invisible radiations; and yet the spectrographic evidence seems to be against this sought-for absorption of light in space. Another question awaiting solution is whether there is a "dispersion" of light in space; *i. e.*, whether there is a retardation of say the violet rays as compared with the infra-red rays, so that the infra-red rays get here quicker than do the violet rays. This can be determined by measuring the radiation from an eclipsing variable star. If there is a retardation of some of the rays then the maximum and minimum of light emission should be different for different parts of the spectrum. This, however, opens up a new question of infra-red radiation from a dark comparison star, which may cause the eclipse, and it does not seem desirable to prolong this speculation.

It is an easy matter to indicate the problems demanding solution. It is quite a different matter to produce the instruments for their solution and in leaving now the discussion of the results obtained in the present investigation it is desirable to emphasize once more that the advance made thus far in developing astroradiometric instruments is very small in comparison with what will be required in order to make real progress in the work. For example, in the pioneering work of Nichols about fifteen years ago, the radiation sensitivity of his instruments was such that a deflection of 1 mm. would have been produced on his observing scale by a candle removed to a distance of five miles. The sensitivity of the radiometric apparatus used in the present work was more than 100 times as great, so that 1 millimeter deflection would have been produced by a candle removed to a distance of fifty-three miles. However, the real knowledge will not be gained by measuring the total radiation from stars, but by dispersing the starlight and meas-

uring the distribution of energy in its spectrum. This is the dream of the experimenter, and it is the goal toward which he has turned his efforts. But, in order to accomplish useful results, the present investigation shows that the radiation sensitivity must be still further increased by a hundred-fold. In other words, the radiometric outfit (including the reflecting mirror) must be sufficiently sensitive to detect the radiation from a candle at a distance of more than 500 miles. The instrument must be 10,000 times more sensitive than the one used by Nichols fifteen years ago, and perhaps from 100,000 to 500,000 times more sensitive than those used in the earliest attempts by Huggins and others, almost half a century ago. This shows how insignificant has been the gain in sensitivity in comparison with what will be required in order to accomplish much on the radiation from stars. It will be a nerve-racking investigation; but it is not so appalling as the above figures may indicate. Large reflectors are becoming more common every year. However, a very large reflecting mirror may not be desirable. The gain in light-gathering power in a very large reflecting telescope is not at all proportionate to the cost of manufacture and convenience of operation. The writer used a three-foot reflector, which, although operated by hand, could be set very quickly. If a six-foot reflector had been at his disposal the sensitivity would have been increased by only four-fold. This shows how little is contributed by the mirror, and how much of the burden as regards gain in sensitivity falls upon the radiometer.

The aforementioned extra hundred-fold gain in sensitivity required may be attained by the use of a reflecting telescope having a mirror seven feet in diameter, and by increasing the radiometer sensitivity twenty times. If the sensitivity of the thermocouples used in the present work can be increased two-fold, this will leave the galvanometer sensitivity to be increased ten-fold. By using a special pier for the galvanometer, and by using a light galvanometer suspension in a vacuum, it will not be a very difficult task to increase the galvanometer sensitivity ten- to twenty-fold. It looks, then, as though everything were in our grasp—everything except a six- to seven-foot mirror, set apart primarily for astroradiometric work. When one thinks of all the money wasted in idle pleasure, and in the wars of nations, it is pathetic to realize that but for a few hundred thousand dollars the aforementioned "layman" of this generation might live to see something "practical" forthcoming from the investigation of the radiation from stars.

THE EARTHQUAKE AREAS OF THE EARTH WITH SPECIAL REFERENCE TO THE RECENT ITALIAN EARTHQUAKE

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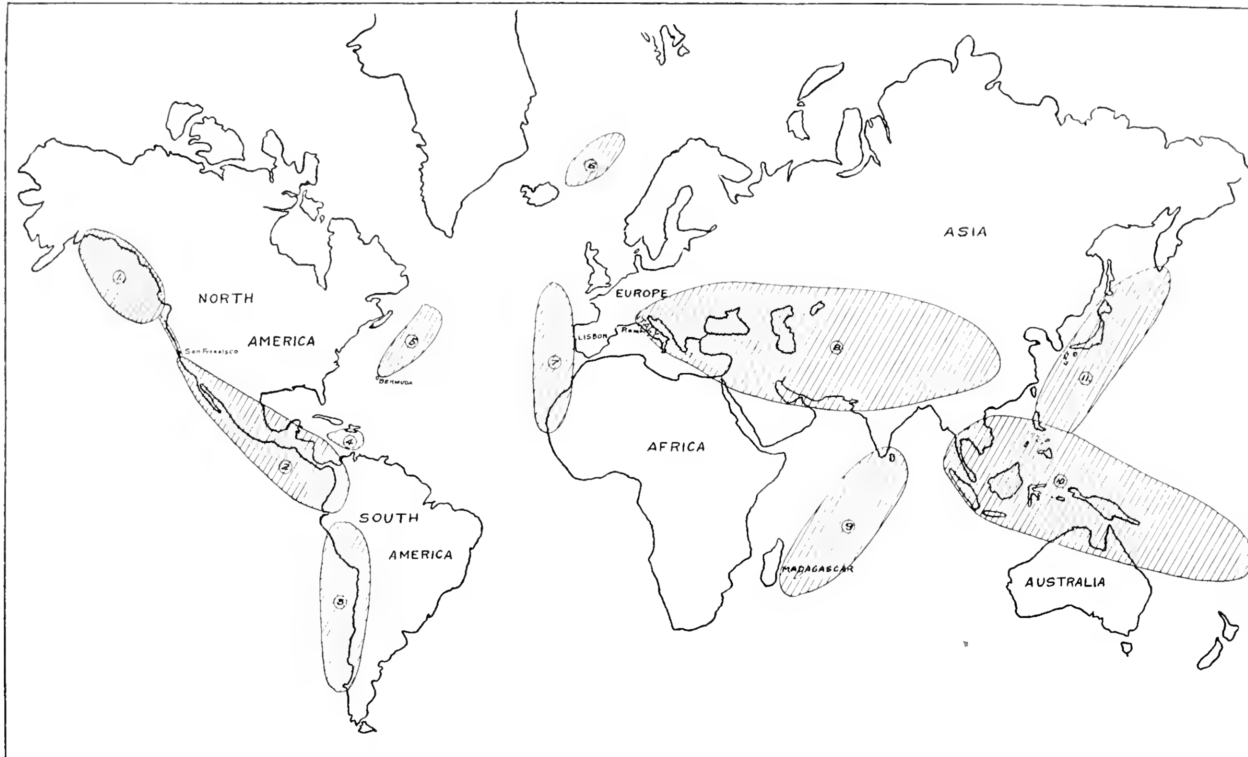
THE recent Italian earthquake, which occurred on January 13 at a cost of 30,000 lives and $60,000,000 in property, calls attention to the fact that the most disastrous shocks of this sort are, in general, not connected at all with volcanoes or volcanic areas. This is contrary, of course, to the view widely held that all earthquakes are caused by, or in some way connected with, volcanic activity. In disproof of this view may be mentioned the great Calabrian earthquake of 1783. This great earthquake occurred in southwestern Italy, but in no wise affected the volcanic areas, and this is also true of the terrible Messina earthquake of 1908, which, though it devastated various towns and cities in that part of Sicily not far distant from Mount Etna, arose from earth movements in the Strait of Messina. It was not at all connected with Etna, which at that time exhibited no unusual volcanic activity, and, too, there were no other evidences that could possibly suggest its connection with the earthquake just alluded to.

The recent earthquake which first occurred east of Rome in the Abruzzi district was followed by severe shocks in the province of Calabria. Neither Vesuvius nor Etna is reported as exhibiting any special activity. Indeed it is evident that they are in no way connected with these shocks which have been so appallingly destructive of life and property.

Broadly speaking, there are two types of earthquakes, namely, the volcanic, which is due to shocks accompanying volcanic explosions, and the more disturbing and disastrous tectonic type, caused by faulting and fissuring accompanying warping of the earth's so-called crust. In Italy, these tectonic earthquakes, such as the Calabrian earthquake of 1783, the Messina earthquake of 1908, and the recent earthquake that wrought such destruction in the Abruzzi district are all of the tectonic type, and all are the result of earth fractures brought about by mountain-making movements. In this connection it will be of interest to consider just what areas of the earth are affected in this way, and why, in certain regions, earthquakes both occur and recur, while, on the other hand, similar earth movements are not experienced nor to be anticipated in regions where mountain-making movements are no longer actively in progress.

The greatest of the Italian earthquakes have been the result of earth fracture accompanied by a succession of destructive shocks. They have been due to the fact that Italy lies within an area characterized by a state of unstable equilibrium. Its mountains and the most lofty mountains of the world, the Himalayas, were uplifted during the last great period of mountain-building—for it must be remembered that not all mountains are of the same age—and that the rocks of the earth had been folded into great arches, upon which were superinduced other folds, long before the uplift of the Himalayas. In other words, most of the highest mountains of the earth are much younger geologically than the older and less lofty ranges, just as the Rockies are vastly younger than the mountains of the Appalachian region, while they, in turn, are much younger than the Blue Ridge—itself younger than the remnants of other mountains which, however, in the attribute of elevation, are mountains no longer—since now only their upturned eroded roots remain marking sites where their masses formerly stood in the long distant past, as great, towering topographic features. Old mountains thus become bevelled off and their sediments may again, in the evolution of the continents, be uplifted elsewhere after eons of ages to form new and even much higher mountains than before.

The cause of the movements of the earth which produce mountains is a long story in itself—and so its discussion here must needs be omitted. For our present purpose it will suffice to say that such movements do occur. Furthermore, they proceed very slowly, so slowly that while such deformations are in progress they may be at such a rate as to be wholly imperceptible and yet, acting through a vast period of time, be sufficient to lift rock formations from beneath the sea to thousands of feet above sea level. In the course of the uplift, accompanied as it is by folding, obviously enormous stresses are developed and from time to time rocks give away and fissuring and faulting ensue; and when this happens the shocks that are felt are said to be the result of what is termed a tectonic earthquake. Later on other movements may occur along a line of weakness produced in this way, and at different points along this line and at different times, just as the California earthquake was the next to the last of a series of eight movements along a well-defined line of crustal fracture. The movements which culminated in the California earthquake began in the north off the coast of British Columbia. The first and third of the series occurred in this region in September, 1899, and October, 1900. They were then felt off Central America in January, 1900, and April and September, 1902. After a lapse of over three years, sufficient stresses had accumulated to inaugurate another movement, upon the southern continuation of the same line. This shock was noted off southern South America on January 31, 1906; and then several months later came the California earthquake



MAP SHOWING THE AREAS OF THE EARTH CHIEFLY AFFECTED BY SEISMIC DISTURBANCES. It will be noted that within certain of these areas are the highest mountains of the world—which were uplifted during the most recent of the world's mountain making periods. Certain other areas are also marked by crustal warpings and such lack of equilibrium as to produce more or less frequent earthquakes.

1. Alaska-British Columbia belt. 2. California-Ecuador belt. 3. Peru-Patagonia belt. 4. West Indian area. 5. Bermuda area. 6. Iceland area. 7. North African-Portugal-Ireland area. 8. Alpine-Himalayan area. 9. South Indian-Madagascar region. 10. Malaysian area. 11. Japan-Philippine area.

of April 18, of the same year (1906). The last and the southernmost of the series occurred on August 12, 1906, and devastated southern Peru and Chile. These various shocks occurred, as stated, along the same line of crustal weakness and parallel to geologically young and lofty mountains, which appear to be still in process of growth. In the same way the Messina, Calabrian, and now this, the most recent of the Italian earthquakes, have all occurred along a line of movement which, starting in southwestern Italy, has experienced movement both further to the southwest and to the north—the last developing along this line of dislocation in the extension of the uplift marked by the Appenines into the division of Abruzzi. Along the same line other shocks will probably be felt from time to time, though there is no telling even approximately as to what the length of this time interval may be. Another series of shocks may occur while this article is being printed, or months, years, or even a century or more may pass before another pronounced movement takes place along the Calabrian-Abruzzi line of fracture; but that it must occur again sooner or later is almost a certainty.

In the regions of old rocks of the earth's crust or in regions of old mountain ranges, a state of equilibrium has been so nearly approached that few earthquake shocks occur. However, in those areas of the earth where young mountain ranges rise or where earth movements are in progress, seismic disturbances are more or less frequent. With the data now available we may map with a very fair degree of accuracy eleven such earthquake areas, all of which are shown on the accompanying map. Also it is worthy of note that the areas chiefly affected by earthquakes are occupied by rocks which are post-Paleozoic in age, and hence, geologically speaking, are relatively young.

The largest earthquake region of the world, which we may term the Alpine-Himalayan area, extends from the Alps to the east of central China. As is shown on the accompanying map, Italy, the eastern Mediterranean, and the warped-down basin of the Caspian, all fall within this area, as do also the Alps, and the young and probably still growing mountain chain of the Himalayas, whose rocks were laid down in the sea at a time, in the geological past, when the Mediterranean formed a connecting link between the Atlantic and Pacific oceans. Within the limits of this region shown on our map, it is estimated that fully 20 per cent. of the more important and widely felt earthquakes occur. The Malaysian earthquake region lies further east. It extends from the Bay of Bengal, across northern Australia, to the region of the Pacific north of New Zealand, and it also embraces all of the East Indian Islands. Its axis probably follows the alignment of the various young and growing mountain regions that traverse the islands of this Archipelago. To the north of the Malaysian belt is the earthquake region which includes the Archipelago of Japan and the Philippine Islands.

As is well known, the islands of the former are almost constantly shaken by earthquakes. This region and the East Indian region, as will be observed from the map, are not sharply marked off from one another.

Along the western coast of North America, there are three earthquake regions. These are shown separately, but as a matter of fact are connected by narrow strips, marking areas of more restricted seismic disturbance. The central belt is thus to be connected, on the one hand, with the southern belt, and, on the other, with the northern belt. The most northern of these three belts lies along the coast of Alaska and British Columbia; the central or California-Ecuador belt, begins in California, includes all of Central America, and ends in Ecuador; the southern, or Peru-Patagonia belt, follows the coast of South America from Peru to Patagonia.

Both the West Indian and the South Indian-Madagascar earthquake regions extend over areas which have experienced more or less profound downward crustal warping. The West Indian region, possessing definite features of marked structural instability, suggest the Malaysian area, which latter, however, is characterized by young and growing mountains, but also exhibits in certain of its parts warping of the kind previously alluded to. The West Indian area is also a region of unusually active earthquakes which are due doubtless to a continuance of the earth's movements by which the old continent of Antilla has been broken up into the islands that go to make the present Archipelago. The South Indian-Madagascar region is supposed to mark the site of a former land mass now vanished under the Indian Ocean. This earthquake region extends from South India in a southwesterly direction to the island of Mauritius and to the east of Madagascar.

The North Atlantic may be divided into three earthquake regions—of these three, one lies northeast of Iceland and parallels the coast of Scandinavia. The second and largest of these three regions extends from North Africa in a northward direction along and past the coasts of Spain and Portugal to the west of the Bay of Biscay, and thence to the west of Ireland. It was along the line of movement here described that there developed the terrible Lisbon earthquake. The third of these areas, which is about the size of the first and the least active of the three, parallels the eastern coast of the United States and includes the islands of the Bermudas.

Some of these earthquake regions, such as the last of the eleven mentioned, are notably free from violent volcanic activity; but, as we have seen, even in a region containing an active volcano the most powerful earthquakes often affect the non-volcanic districts. Thus, to recapitulate, the appalling Calabrian earthquake of 1783, though near the volcanic areas of Sicily and not a great distance from Vesuvius, affected a part of southern Italy where there are no volcanic rocks. The dis-

astrous Lisbon earthquake was also in a non-volcanic area. Likewise, the region of occurrence of the recent Italian earthquake shows that it also is situated in a non-volcanic area. Furthermore, as a general rule —though earthquakes often happen in volcanic regions due to explosive shocks—the most disastrous and most powerful earthquakes occur in non-volcanic areas and are tectonic in their nature. They—the latter— are due to a series of rapid shocks which accompany movements along lines of weakness, such as faults or previously made fissures due to mountain-making movements. The throw of these faults need not be very great in order to produce disastrous results.

The frequent coincidence in the distribution of earthquakes and volcanoes may be said to be due to their dependence upon a common cause, in the sense that volcanoes may be regarded as incidental to and the result of great earth movements. Such movements evidence either the collapse of large areas of the earth's crust, or crustal uplift—each a warping, and both due to movements of an orogenic or mountain-making character. These crustal crinklings, moreover, which occur on a vast scale, are not confined to one period of the earth's history, but have been experienced by the earth at different times since the very beginning and are likely to continue to the end—which, considering the physics of the earth, and various well-known geological facts, appears to be fully as remote as the genesis of the earth itself.

A HISTORY OF TAHITI. III

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SUDDENLY, on September 3, 1803, Pomare I. died, and was succeeded by his son, the weak, savage, drunkard Pomare II.; Who even with European aid was unable to maintain his power, so detested was he even in his own ancestral district. Thus, in 1808, the new "king," together with his ministerial allies, were forced to flee to the Island of Eimeo, the Tahitians under Opuhara of Papara having utterly routed them without a convert having been gained to Christianity.

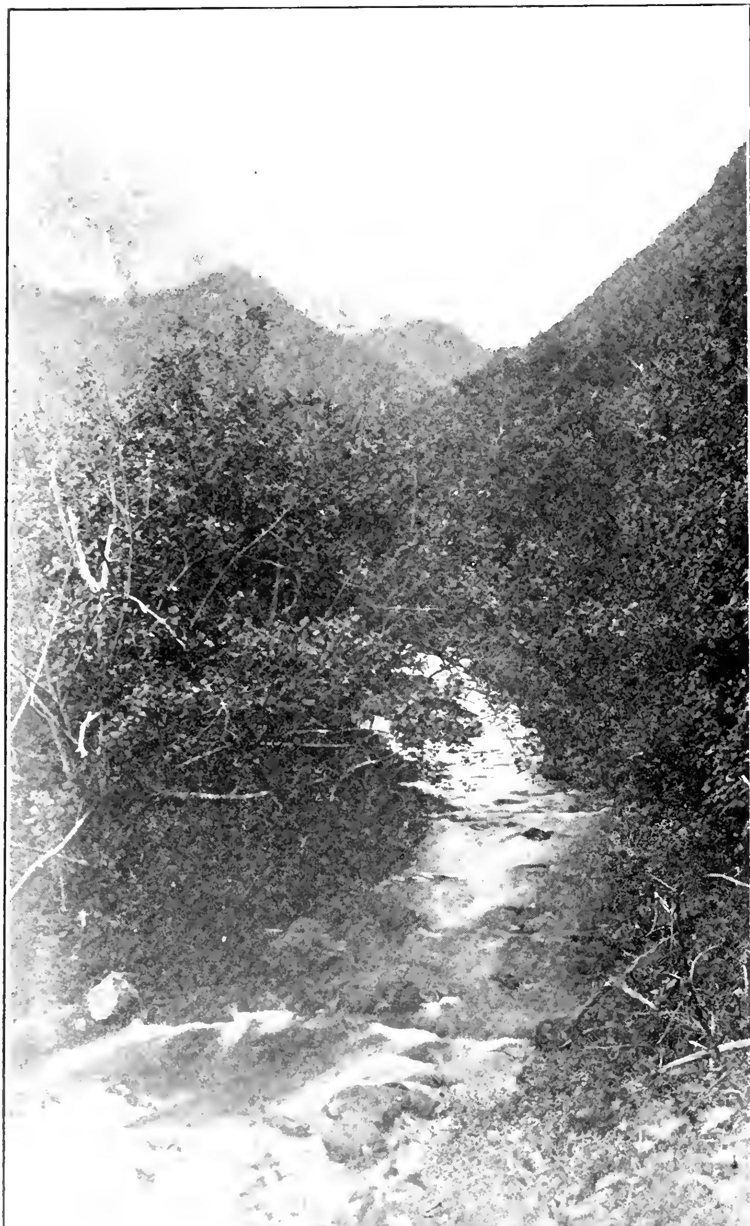
After this, in October, 1809, all but two of the missionaries set sail for Australia, leaving only Mr. Nott and Mr. Hayward, who retreated to the Island of Huahine, leaving their friend the "king" a lonely exile upon the little Island of Eimeo, his "Elba" being but ten miles long and five wide. Deserted and helpless, even his native district lost, Pomare came to realize that his sole hope lay in inducing the missionaries to return to his aid. Thus, in 1811, did Pomare II. regain his allies, exhibiting his "change of heart" by begging for baptism from their hands in July, 1812.

This case is by no means unique among the annals of missionary success in the Pacific, for Thakombau of Fiji became a convert only when missionary aid became indispensable to maintain his power, and George Tubou of Tonga gained greatly in material things through his acceptance of Christianity.

In order to appreciate the victory of the missionaries in causing Pomare to accept Christianity, we must remember that the high chiefs in Polynesia were leaders in spiritual far more than in temporal things, and conversion was tantamount upon their part to an abnegation of their godly origin. Thus it was that at first no natives would follow the example of Pomare, all believing him to be mentally deranged. His act seemed that of a Sampson who in despair had crashed the temple upon his own head.

Converts followed slowly, some from conviction, others probably perceiving, as Pomare appears to have done, the worldly advantages to be gained, and thus in 1813 the idols of Eimeo were publicly burned to the great joy of the missionaries, who thereafter gained rapidly in political power and religious authority, arming their converts with both guns and Bibles.[6] Thus in 1815 the missionary party became strong enough to invade Tahiti: and in November of that year they gained a

[6] See "The Memoirs of Arii Taimai," p. 160.



"The Diadem," Fautaua Valley, Tahiti.

decisive victory, killing Opuhara, the leader of "the Conservatives," and enabling Pomare to capture and destroy the idol of the great god Oro, the "ancestor of the chiefs," a huge, uncarved log covered with red and yellow feathers. Thus through methods savoring more of Mahomet than of Christ was Tahiti converted.

Soon all old customs were crushed out; European clothing and manners were introduced, and rigid laws were enacted obliging all to conform to the outward forms of Christian worship.

A priestly despotism similar to that which prevailed in the seventeenth century in Puritan New England was inaugurated; the Sabbath commencing on Saturday afternoon every one being obliged under penalty of a heavy fine to attend the services of the church. To-day, in the Ellice and Gilbert islands and in other remote parts of Polynesia, a similar tyranny is maintained.

Pomare was "king," but his power was broken never to be restored, and the actual government of Tahiti was in European hands.

The tabu system having been destroyed, Mr. Nott, one of the original missionaries, devised a code of laws in 1819, the "king," chiefs, and people all approving by raising their hands at a public gathering. These laws were still further elaborated in 1826 and were designed to provide a regular system of taxes (tribute), and penalties. The following table may be interesting, for it serves to give an insight into the mental character, spirit of toleration, and power to enforce their rule enjoyed by the missionaries:

Crime	*Penalty*
Working on Sunday, first offense.	To make a road 300 feet long and 6 feet wide.
Working on Sunday, second offense.	A road 660 feet long.
Stirring up rebellion.	A road 660 feet long.
Murder or infanticide.	Banishment to some lonely island for life.
Bigamy for men.	A road 240 feet long and 6 feet wide.
Bigamy for women.	To make two floor-mats.
For being tatooed.	A road 60 feet long, and the tatoo-marks to be obliterated by blacking them over.
Drunkenness in men.	A road 30 feet long.
Drunkenness in women.	Two large mats.
Stealing a pig.	A fine of 4 pigs, two for the owner and two for the king.

As Ellis says

> the law which prohibits labor on the Sabbath day is perhaps enforced by a penalty disproportionate to the offense.

In most of these penalties a part of the fine went to benefit the king or district chief, who thus profited through the dereliction of his sub-

House and Natives of Bora Bora, Society Islands.

jects; and the system of espionage and development of hypocrisy and deceit resulting from such a system may well be imagined, or, if not comprehended, may be observed to-day among the natives of the Ellice and Gilbert Islands.

Having given Tahiti a code of laws, the missionaries proceeded to write out the plan of a "constitutional monarchy" and a "parliament" patterned upon that of England, but Pomare and the high chiefs would have none of it, and the scheme could not be thrust upon the natives until after the death of the king in 1821; when owing to his son Pomare III. being an infant, a "regency" was established and the power of the missionary party was much augmented, although always opposed by the conservatives under Tati, chief of Papara.

Thus in less than a decade were the Tahitians driven over the road of political and social progress that Europe had toiled a thousand years to traverse. The natives were forced to harken to the voices of men of an alien race whose traditions differed wholly from their own, and who looked with ill-concealed contempt upon the religion, folk-lore and arts of old Tahiti, forgetful of the fact that there was much in native culture that was good and should have been encouraged as a basis for future development.

Perhaps the saddest mistake that has been made in the universal attempt to introduce our civilization among the simpler races has been the destruction of almost all that once was theirs in the hope that things of our own creation might arise. Instead, the natives have lost much and gained but little. Under friendly direction, the wonderful

wood carving of the Maoris might have been preserved and modified to find a profit-producing market for the natives. The embroidered mats of the Marshall Islanders were the admiration of all who beheld them, so beautiful were their designs and soft their texture. Even so low a race as that of Australia can produce basket-work of superior quality which if honestly encouraged could provide a means of attaining affluence from the native standpoint. The salvation of their very souls lies in the maintenance of their respect as self-supporting men and women, yet even while we preach morality, we permit their only hope of maintaining it to dwindle through our own neglect to find a market for the fruits of their labor and invention. Yet, happily, a ray of hope has come, and on the island of Badu in Torres Straits a laudable attempt is being made

Council House at Paaia, Tahiti.

by an incorporated English company under the direction of the Reverend F. W. Walker to teach the natives money-making arts and trades and, above all, to procure and develop a market for their wares. No surer road to the attainment of civilization and Christianity could be found and there is a most significant contrast between the industrious, happy natives of Badu, whose faces are alive with intelligence, and hope, and their listless cousins of other islands in Torres Straits.

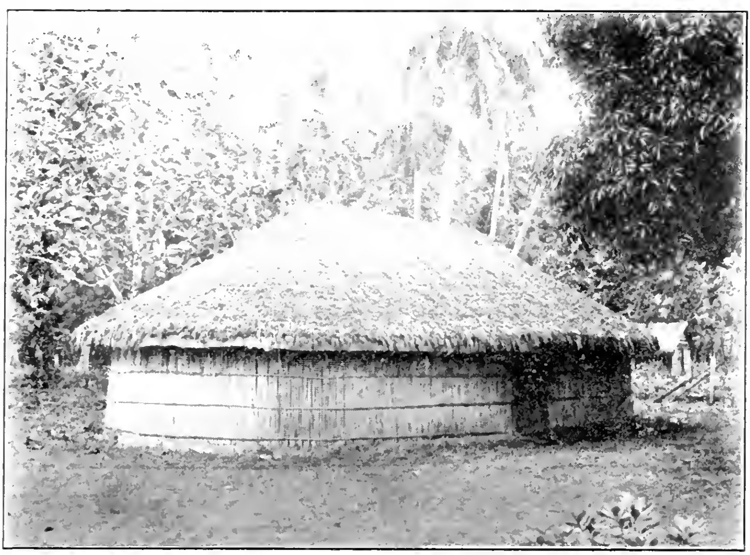
Perhaps it was but natural that these early Tahitian missionaries grew too greatly to fear mistakes upon the part of the natives, forgetting that the teacher must not do the reading for the child.

A semblance of order and rectitude fell over the stultified life of the natives, while hidden beneath the surface vile things survived concealed. Such a vision of "righteousness" one sees among that most "orderly,

HOUSE NEAR PAPARA, TAHITI.

well behaved, and moral" community: the convicts of our own state's prisons. Yet progress lives only where action is free to try the unknown, hoping that despite mistakes truth may thereby be revealed, and in proportion as men have won this right does bigotry lose its hold upon their souls.

Yet happily there are other and more important sides to this picture



NATIVE HOUSE AT PAPARA, TAHITI.

of the work the missionaries accomplished in Tahiti. Rather the truth is that, realizing the fundamental good they accomplished, we, in our regret for their partial failures, are disposed to dwell too deeply upon the darker side. Let us therefore not forget the better things they wrought for, and the difficulties which their courage surmounted. Had they not come there would be no native race living in the Tahiti of to-day, for with their success, the institutions of infant murder, human sacrifice, native warfare and the society of the Aroei disappeared forever from the land.

Nor must we overlook the bravery of this little band, every one of whom had been threatened many times with death, and at least one of whom had fallen a victim to native hatred. Friendless and far from home, alone, and unprotected, they had labored steadfastly throughout the long sad years of apparent failure, and it seems but natural that in the end they became in some measure the victims of the elation of success.

It was fortunate that from 1817 to 1824 William Ellis, a kindly, tactful and courageous man lived as a missionary upon Tahiti, for not only did he give us in his well-known "Polynesian Researches" the fullest account extant of Tahiti in old days, but his efforts were directed toward encouraging new industries to take the place of many occupations which had been lost.

Among all the missionaries, Ellis appears to be the only one who expressed regret at the abeyance of such harmless sports as archery, surf-board riding, playing with miniature canoes, flying kites, and swinging upon ropes; for the Tahitians were not gamblers as were the Hawaiians; but he says

> the adults [Tahitians] do not appear to have thought of following this [archery] or any other game since Christianity has been introduced among them.

Moreover in Tahiti, as elsewhere under the domination of European culture, the native crafts of wood-carving and tapa manufacturing were discouraged and lost, and the great double-decked canoes one hundred feet in length with their ornately carved bows curving upward, were made no longer, and even the Ariirahi's state canoe, called the Anuanua (the rainbow), was doomed to disappear.

In speaking of Tahiti as it was in 1839, Admiral Charles Wilkes, who always champions the introduction of European culture, says:

> The change of dress which has been introduced by the missionaries, and other foreigners, has had an injurious effect on the industry of this people. While they wore the native tapa the fabric, though of little value, gave employment to numbers of women; and this change of dress intended as an advance in civilization, has had the effect of superseding employments which formerly engaged their attention and occupied their time. The idleness hence arising, and the artificial wants thus created, have no little influence in perpetuating licentiousness among the females, to whom foreign finery is a great temptation.

In old days beautiful bowls, pillows and seats were carved by the natives out of single pieces of wood, but these also were doomed when brought into competition with even the crudest articles of European manufacture, and moreover their symbolism was repugnant to the new regime, for it maintained the memories of old traditions.

EASTER ISLAND STONE IMAGE IN THE GARDEN OF THE ESTATE OF JOHN BRANDER, ESQ., AT PAPEETE, TAHITI.

It should be said that in 1818 the missionaries sought to introduce such civilized employments as the manufacture of cotton cloth, and the cultivation of sugar, coffee and tobacco, and the making of lime for the concrete required in the construction of the ugly, stuffy, little stone houses which were intended to supplant the well-ventilated native thatch. They even went so far as to import a Mr. Gyles from Jamaica to introduce the manufacture of sugar from the cane. He succeeded, but Pomare and the chiefs became fearful that should the industry prove commercially profitable foreign men-of-war would descend upon

Tahiti and the natives would be deprived of their lands and reduced to slavery as were the Indians of the West Indies. The opposition of the chiefs was of so determined a nature that the missionaries deemed it advisable to desist from their attempt, and their effort to introduce a cotton-cloth mill met with similar discouragement.

Indeed, it is doubtful whether the child-like natives would have been either happier or better as mill hands laboring eight or ten hours a day in distilleries or factories than they were each in his own house beneath the palm groves and depending upon the rich bounty of the land and sea for food and clothing. These European autocrats sought in all reforms to begin at the top, and had they displayed the good judgment to teach merely the rudiments of religion, government and agriculture, and to encourage and develop a market for the crafts the natives already practised, they would probably not have felt obliged to complain to Admiral Wilkes that "sincere piety was rarely to be found among the natives."

In 1821 a rebellious return to idolatry broke out among the young and aristocratic element, and after this was sternly suppressed a fanatical sect, the Mamaia, arose in 1828, their leader claiming to be Christ and promising a sensual paradise to his followers. The natives who at first had expected miracles from the white man's god, were now beginning to lose faith and interest and to loathe the dull life their masters forced upon them, and in 1839, when Admiral Wilkes visited Tahiti he was surprised to find the attendance upon worship on Sunday to be small, less than 200 being present in the church, and most of these being women who "did not appear to be as attentive as they had been represented." These women, he says,

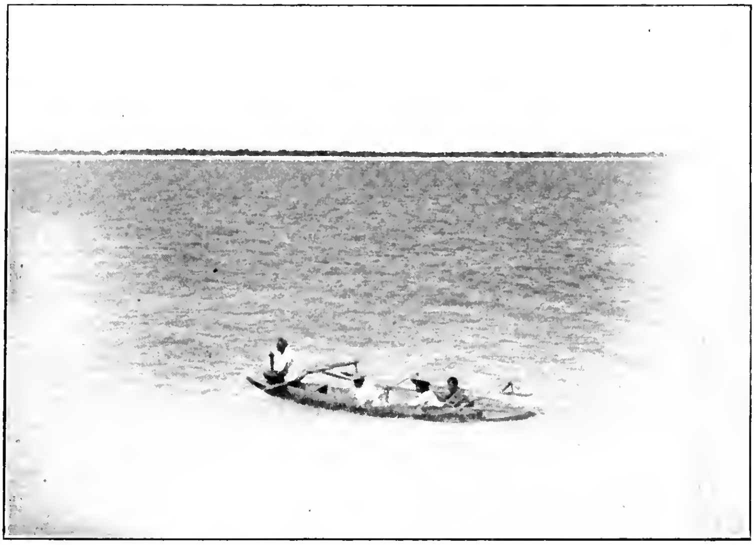
> were dressed in a most unbecoming manner in high flaring chip bonnets of their own manufacture, loose gray flowing silk frocks, with showy kerchiefs tied around their necks.

The time has come when the natives of Polynesia are beginning to appeal for freedom to govern and maintain their own churches and under ministers of their own race; to suffer from their own mistakes and win their own achievements.

Yet a great task still remains to the European co-worker for their enlightenment, for everywhere there is a crying need for manual training and technical schools patterned upon the general plan of Booker Washington's Tuskegee Institute. Above all, markets must be sought and developed for the wares and produce of the natives, for most of their present apathy is due to the fact that they can obtain no adequate remuneration of the products of their labor, but are, in effect, penalized for their very industry through the rapacious acts of traders.

Moreover, the present rule of the religious autocrat, essentially altruistic and high minded as it is, has produced only obedient or servile

children. Justice demands freedom for the Polynesian—room in which to struggle and to rise. It is an inadequate defense of the present system to say that it is immeasurably more humane than the savage rule of the old chiefs, for it has proven itself incompetent to raise a single native race into a position of self-supporting independence. We have given them the Bible, but we still withhold from them the means to win their moral self-respect. In other words, the task of the European is



CANOE AT NUKUTAVAKE ATOLL, PAUMOTUS.

but half completed, and the effect of leaving it at this stage is all too apparent in long settled regions such as the Hawaiian Islands, where, after the most easily attained conversion in the history of the Pacific, the natives have steadily sunken, and are to-day a degraded, downcast remnant—mere peons of commercialism, their past forgotten and their future hopeless.

How different this history might have been if along with instruction respecting the lives of Adam and Eve, Abraham, and Sampson, the missionaries had maintained the native arts, modifying them to meet the demands of markets which might have provided the native race with a means of livelihood and replaced the lost ambition due to the abolition of war. Beautiful wall papers and screens might have been made from the delicate tapas of old Hawaii, and their women were once skilled to an unusual degree in feather work and weaving.

We speak of the island races as being "lazy," forgetting that there is as yet no adequate reward for their labor. When opportunity offers, they strive well, as in the crude process of the copra industry, which, after

having been introduced by the great German merchant, Godeffroy, in the middle of the nineteenth century, has proved to be the commercial salvation of Polynesia.

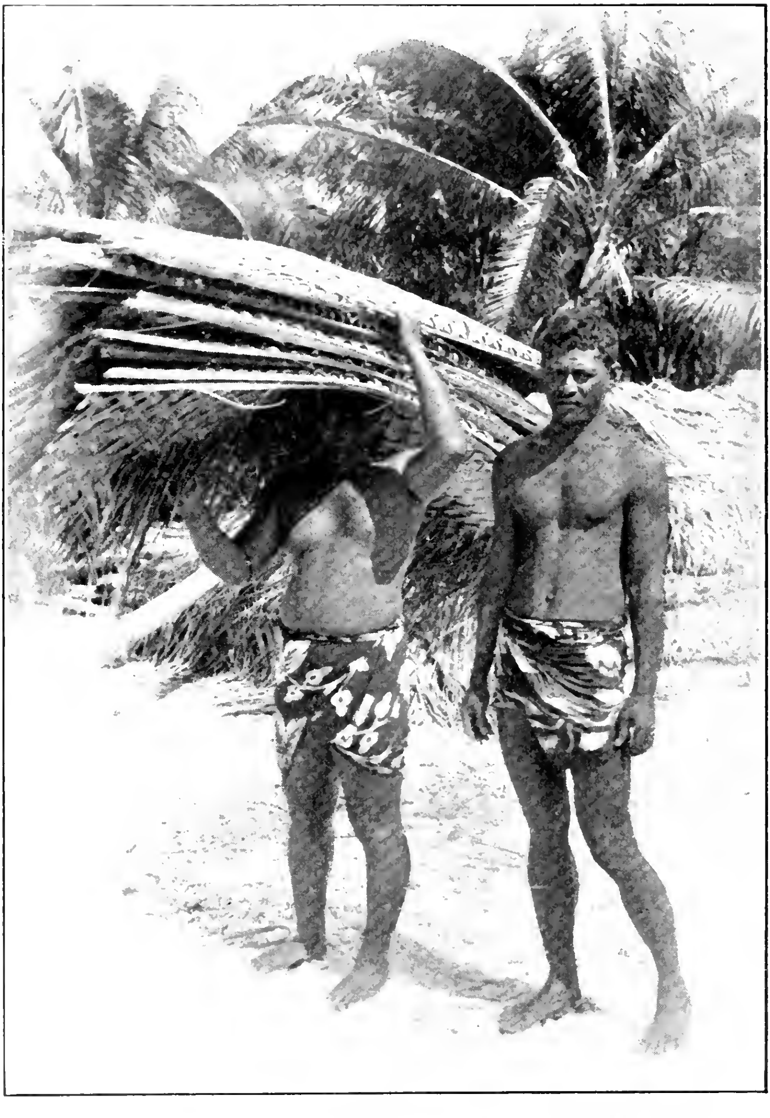
But to return to the political history of Tahiti. On December 7, 1821, Pomare II. died as a result of long-continued drunkenness, and on April 21, 1824, his son, a boy of four years, was crowned by Mr. Nott, one of the original missionaries as "Pomare III., constitutional king of Tahiti." The education of the young "king" was at once undertaken by the missionaries, but on January 11, 1827, he died of an epidemic which was then ravaging the island; and Aimata, his half sister, was proclaimed queen, taking the name of Pomare-Vahine (The Lady Pomare), although more commonly known as "Queen Pomare IV."

At the time of her accession she was only about thirteen years of age, and thus dependent upon the missionaries for advice, and, as the sequel proved, rarely was queen more in need of broad-minded and tactful advisers, for the end of Tahitian independence was at hand, and the fateful question was—should England or should France assume the government of the island?

Several elements in the foreign population were causing trouble to the natives, these being the traders who sought to bleed the Tahitians of all the little wealth they possessed, the degenerate deserters from ships and other parasitic whites who were a constant source of demoralization, and the sons of the missionaries, who, in general, lacked the altruism of their parents and sought to acquire land and to exploit the Island at the expense of the natives. Conditions such as these have worked themselves out in the Hawaiian Islands, ending by the descendants of the missionaries acquiring nearly all the lands the natives once possessed.

In Tahiti the native chiefs, following the policy they adopted in respect to the cultivation of sugar cane, had determined to discourage the permanent residence of white men among them, and had steadfastly refused to sell or even to grant long leases to their land, and thus the natives as a race were still independent home-owners, and happy in the enjoyment of their accustomed means of obtaining sustenance.

The salient fact is that the white settler in the tropics is concerned chiefly with his own profit, and but little with the elevation of the native race. Through artificial devices designed to restrict the liberty of the natives, or through the imposition of high taxes, the white man virtually peonizes the native race and forces the brown man to labor far beyond the little effort required to provide all his natural needs, and in the end the profit accruing from such toil is found in the pockets of the white man. To-day over those parts of the tropics wherein the white man gains a profit from the land, as in the Dutch East Indies or in parts of Africa, this modern ingenious form of slavery pertains. In other



PEARL DIVERS MOVING THEIR HOUSE, HIKUOM ISLAND, PAUMOTUS.

words, a form of commercial peonage has replaced the old possession of the body of the slave, and only in proportion as the land is poor, or markets far away, is the native rich in communal liberty.

These facts, well appreciated as they are by the natives are the chief causes of racial distrust, for the native realizes that the European is his exploiter, not his friend. Unable to maintain his ground in open contest, he has recourse to all manner of subterfuge. Much of his so-called "laziness" and "lack of ambition" results from these conditions, for while he is sufficiently industrious and often hard working in so far as his own personal needs and profits are concerned; if he can by any means avoid working for the white man's benefit he will do so, even though he must himself endure privation to accomplish this end.[7]

Events in Tahiti moved slowly, for the age of the steamship had not yet come, and the South Sea Islands were still remote from the world's activity.

In 1835 the Catholics began to establish missions among the Pacific Islands, and thus the French government acquired a plausible reason for sending men-of-war into the Pacific, avowedly to afford protection to these missions, but in reality to expand the realms of France.

In Tahiti the drama opened when two French priests, Fathers Laval and Caret, embarked upon a small schooner from Mangareva and landed on Tahiti on November 21, 1836.

The antagonism between the protestant missionaries and their catholic co-workers was well known to these French priests, and thus they avoided Papeete, the only port of entry, and sought a landing upon the remote coast of Tautira on the eastern side of the Island. They then walked slowly along the shore toward Papeete preaching at frequent intervals, and gaining the ears of Tati and other leaders of the old conservative party whose aspirations had been crushed by the missionary element in 1815.

Henceforth the struggle lay between the protestants and the French, the Queen being but a puppet in the hands of Mr. Pritchard, a missionary who was then serving as British Consul; and the upshot of the affair was that on December 13, 1836, the priests were expelled from Tahiti for having failed to respect the port regulations in landing surreptitiously at Tautira; their offer to pay the statutory fine being refused by the Queen.

But the martyr spirit was as strong in these French priests as in their protestant adversaries, and with unexpected suddenness they reappeared, this time as passengers on the American brig *Colombo* which anchored in Papeete Harbor on January 27, 1837. Their application for per-

[7] A most interesting and thoughtful analysis of such conditions has been given by Sir Sydney Oliver, former Governor of Jamaica, in his book upon "White Capital and Colored Labor."

mission to land met with a prompt refusal, and with their disappearance the curtain falls upon the first scene of the drama.

The second opens when on August 29, 1838, the French frigate *Venus,* under Commodore DuPetit-Thouars, bore down upon Papeete, and, training her guns upon the town, demanded first an apology, second 2,000 Spanish dollars, and third a salute of twenty-one guns for the French flag.

The native sources of money-revenue were derived largely from washing done for ships, of which employment Her Majesty and the high chiefs enjoyed a monopoly, and the hopelessness of attempting to pay this enormous indemnity was so overpowering that in her despair the Queen is said to have advised the ceding of the entire Island to the French.

Even had the town been shelled, retreat to the hillsides would have given the natives hardly more concern than in the days of Wallis, but it was far otherwise with the English residents, who, moreover, were already scheming for a British protectorate. Thus the foreign residents came to the aid of the Queen and the indemnity was promptly paid, the French, however, being obliged to provide the powder used to salute their own flag, for, as Mr. Pritchard states in his "Polynesian Reminiscences," upon the entire Island there was not sufficient powder for more than five of the twenty-one shots required.[8]

The French Commodore then demanded a treaty by virtue of which Frenchmen of all professions were to be permitted to establish themselves upon Tahiti; and after obliging the Queen to accept a French Consul of his own choosing, the *Venus* sailed away.

Most unwisely, immediately after the departure of the *Venus,* the Queen, instigated by Pritchard and the missionaries, issued a law forbidding the teaching of Roman Catholic doctrines in Tahiti; when, like a bird of ill omen, another frigate *L'Artemise* rose above the horizon, but in approaching the island she struck so heavily upon the coral reef that had it not been for native aid in towing her into Papeete Harbor she would have sunk. No sooner were her injuries repaired, however, than her captain, running out his guns, demanded equal rights for both Catholics and Protestants, and the cession of a site for a Roman Catholic church. Soon after this in 1841 the chiefs of the old conservative party applied to France for protection; the Queen, instigated by Pritchard, having already addressed a similar appeal to England.[9]

A semblance of peace then fell upon the scene and for several years

[8] This event is depicted in Plate No. 53 accompanying the "Voyage autour du monde" by A. DuPetit-Thouars, Paris, 1841.

[9] Great Britain responded by a pleasing but non-commital letter, and a gift to the queen of some household furniture, which through an irony of fate arrived just in time to be of service to Bruat, the first French Governor.

the wide waste of the Pacific seemed to afford the protection of isolation to the little island. But the government of Louis Philippe was casting covetous eyes upon the Pacific, usurpation at home having bred aggression abroad; and in September, 1842, the sails of another frigate, *La Reine Blanche,* rose and shaped themselves upon that eastern horizon whence in other days Wallis, and Cook, and Bougainville had come, and the evil genius of Tahiti, DuPetit-Thouars, once more frowned down upon the affrighted land.

MORAL PROGRESS

By F. STUART CHAPIN, Ph.D.
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MORAL progress has two aspects: one, social and psychological; the other, individual and biological. The former appears to have a superficial, temporary and changeable basis, with an element of compulsion; the latter appears to be fundamental, permanent and spontaneous.

Moral conduct may be secured by the compulsion of tradition. Usages and customs exert a "steam-roller" effect in crushing out anti-social conduct. The preparation and selection of foods is almost entirely a matter of custom. Custom and style set the standards of what sort of attire is proper under given conditions. We have police ordinances which specifically prohibit indecent exposure in public places. In business relations, certain standards are recognized and some usages have received quite general acceptance. We have laws which punish felony and misdemeanor. To ignore this body of tradition is to invite social ostracism or even more summary punishment.

But most of us are subject to strange and inconsistent moral lapses. The loving father and generous husband is too often brutally unscrupulous and cruel in his business dealings. Unexpected disclosures frequently show how many of our "respected citizens" are patrons of houses of ill repute. Thus there is one code of morals in the family and another in business and outside life. Corrupt politicians are often model husbands and staunch friends, yet they feel no scruples at taking the public's money. They regard "graft" as legitimate gain. In a lesser degree, church members and moral leaders will not hesitate to cheat the transit corporation of a rightful carfare. Wealthy men will give large sums of money to charity with one hand, and with the other ruin a competitor by cut-throat methods, or solemnly dispose of worthless watered stock in a market of credulous buyers. "Gentlemen farmers" who want to liquidate a bad real estate investment will dump garbage and turn hogs into a stream which supplies a neighboring town with drinking water, in order to force the purchase of their land by the fever-threatened community. A flimsy pretext precipitates the holocaust of Europe. Thus moral conduct is often but a thin veneer which covers up unsuspected depths of primitive brutishness and crude impulse.

On the other hand, we all know certain men and women of our acquaintance who in nearly every situation seem to do the wise thing,

while others can invariably be counted upon to do the wrong thing. Halfway between, most of us stand by in hesitation. These naturally moral individuals who seem to have an innate sense of honor and proportion are found in all walks of life. They appear to be types whose general attractiveness and good sense are recognized by all classes with whom they come in contact.

Thus moral conduct which is the result of repression of anti-social impulse is but a negative social virtue. Moral conduct which is the result of spontaneous action is a positive social virtue. The former is analogous to the veneer which covers up the basic crudeness; the latter is analogous to the solid rare wood.

Historically considered, moral conduct seems to have been most frequently of the psychological sort—very rarely of the biological sort. Rigid customs and established usages have from time immemorial sought to reduce variable human units in China and India, to spiritless followers of prescribed conduct. Each new generation is remorselessly trained to mechanical practises, the following of which is thought to signify moral conduct. Oriental peoples have proceeded farther than Occidental peoples in the direction of rigidly standardizing conduct. May not the adoption in recent times of some of the freer western standards by the supposedly tradition-bound east, be taken to signify the superior practicability and greater value of plastic standards over rigid ones?

But moral conduct by compulsion is a social policy not exclusively confined to Oriental peoples. We of the western world have had our experience with political and religious intolerance. Often the compulsory production of moral conduct has been carried to such extremes that it has become more than a repressive force, it has become a selective agency. Witness the case of the Roman Catholic inquisition. By the exaction of celibacy and by the torture and death of unorthodox and original persons, the perpetuation of the most intelligent stock was hindered. The enforcement of compulsory standards of moral conduct and the extermination of the intellectual, effectively rooted out of society many of those people who had within them the possibilities of *genuine* social conduct. In this way customs have been so rigidly preserved that it seems as if their chief object has been to crush without discrimination all variation from the prescribed conduct. The ultra-conservative elements of society seem to consider that the extension of the sphere within which custom works to the line in ironing out all innovation and in rigidly standardizing conduct, is the best possible evidence of moral progress.

In recent times we have begun to think that genuine moral progress consists in the loosening up and in the simplification of binding customs. That flexible state of tradition which is consistent with the

closest adaptation of conduct as a means to the end of securing the greatest amount of enduring human happiness, is the goal. To this end we must steer between lax standards which allow license, and rigid standards which produce hypocrisy. We must avoid, on the one hand, that extreme of rigid regulation which unintelligently crushes out all variation and preserves only the spiritless, and, on the other hand, avoid that total absence of social conduct which is anarchy. Now this middle course is possible only when a majority of the people are moral by nature. The reason for this is the fact that most people need the constant pressure of custom to force them to lead thoroughly moral lives, hence only the naturally moral person will lead the moral life in a society of plastic standards. The problem of moral progress is therefore twofold: first, of creating flexible standards which will allow variation and adaptation to changing needs; second, of securing the preservation and perpetuation of a human stock that may be depended upon to lead moral lives without the necessity of much social compulsion.

In considering these problems, it should be noted that during the historical period there appears to have been little, if any, improvement in the innate mental constitution of man. While other animal species have advanced because of improvement in the stock, man's progress has been chiefly due to improvement in the *content of his tradition,* which, as generations have come and gone, has been worked over, until, by the gradual elimination of the superstitious, superfluous, irrational and inconsistent elements, it has become more elastic and better adapted to changing needs and interests. This progress can be well illustrated by a comparison of the content of the mind of primitive man with that of modern man. The tradition of many primitive groups is that disease is an *object* which can be driven or frightened away from the body of the sick person by proper charms, dances and alarming noises. After one of these grotesque ceremonies, the medicine man exhibits a quartz crystal which is supposed to represent the disease that he has taken from the person in the course of making him well. Compare this with the modern notion that disease is a disordered condition of the mind or body, and that by rest, proper food, care, drugs, and exercise, the body can be restored to a normal healthy condition. As a means to the end of curing the sick, the primitive method is quite wide of the mark, ridiculously crude as compared with the efficient methods of scientific medicine—vaccination, anti-toxin, antisepsis and aseptic methods. The difference between the two systems is simply that our modern methods are the result of a longer experience, during which, in the course of experiment, trial and failure, we have learned to eliminate many superfluous efforts and inconsistent practises. Thus the usages of civilized man are more efficient instruments to certain ends than are the customs of primitive men.

In recent times the improvement of the great body of human tradition has been greatly accelerated by remarkable advances in the means of communication. Under the incidence of those broadening influences represented by the press, the railroad, the steamship, the telegraph and the telephone, local prejudices and customs are gradually breaking down. The enormous expansion of commercial enterprises and the ease of travel have developed a tolerance of thought undreamed of a few generations ago. We do not hear so much in these days of the "Heathen Chinee," and much of the virulence of other national and racial prejudices has been softened. Communities which have developed picturesque usages on account of their isolation from the great current of human thought and ideas at the swarming centers of civilization, are gradually losing their old-time seclusion with the introduction of the railroad, the telegraph, the telephone and the camera. By overcoming the restraining conditions of time and space, the great modern inventions have combined to loosen up the former rigidity of tradition, thus making for more flexible standards.

But as we have stated above, the enduring character of a civilization whose standards are fluid and plastic, depends upon the quality of the people. There appears to be no scientific reason for believing that the mind of modern man is in any marked way superior to the mind of primitive man. The reason for this is found in the fact that improvement in the innate mental constitution of a species comes only through the agency of selection, the extermination of the dull and unadaptable, the preservation of the alert and adaptable to be the progenitors of future generations. Now natural selection is not as great a factor in the lives of human beings as in the lives of other animals. Because of his greater cleverness, memory and foresight, man has been able to protect himself from many hostile forces and has materially modified the ruthless struggle for existence. Thus it has been that many individuals unfitted for a more rigorous existence have had their lives prolonged to leave more than their natural quota of sickly offspring. For this reason, leading authorities agree that there has been little improvement in the innate mental constitution of man during the historical period. In proportion as he has simplified his tradition and made of his customs more efficient instruments, man has learned to control the forces of nature which worked him harm and has been able gradually to limit the sphere within which pitiless natural selection operates.

At the present time our traditions are openly or indirectly, as the case may be, hostile to natural selection as a means of human improvement. Humanitarian ideals, democratic principles, Christian beliefs and medical practises, are unalterably opposed to the ruthless extinction of the unfit. Yet our *mores* need to have injected into them the idea that abiding human progress can come only through the improvement

of the stock of the people. Under modern social conditions improvement in the human stock can come only through securing an approximation to the selective birth-rate, since our traditions are uncompromisingly opposed to the cruelty of the selective death-rate. Therefore we ought to get into our *mores* the idea that the children of the present generation must be born of physically healthy and mentally capable parents, the idea that the propagation of the weak and defective human stocks must be stopped by humane but firm methods. If this can be done, then we shall have overcome most of the bad consequences which have resulted from our interference with the extinction of unfit members of the human race on the grounds of sympathy, mercy and pity. An approximation to the selective birth-rate is all that is practicable under the present democratic constitution of society. But since natural selection still exterminates the grossest cases of unfitness (imbeciles die before thirty years of age, consumptives die early, children of mothers and fathers who die young generally die before leaving the normal quota of offspring), the establishment of an approximately selective birth-rate will effectively limit the procreation of the other undesirable classes. In this way the cruelty of ruthless natural selection will be avoided and yet the perpetuation of the better stock secured.

Modern states have already embarked on programs of social legislation which aim at checking the multiplication of the unfit. In some states, health certificates must precede the granting of marriage licenses. In other states there are laws which require the sterilization of congenital criminals. Massachusetts is at present endeavoring to secure the segregation of feeble-minded persons during the reproductive period. In all of these ways we are endeavoring to secure an approximately selective birth-rate. What is required if this notion of the selective birth-rate is to become a widely recognized standard, is to get the idea of *better parentage* into the *mores* of the masses as the necessary complement of humanitarian, democratic, Christian and medical ideas already traditionalized. When this has been done we shall have secured a guaranty of continuous and abiding *moral progress.* Already the word "eugenics" has been taken up by popular periodicals and newspapers. *Life* pokes fun at the idea and the press has learned to use the word. Realizing that the concept of better parentage may be gotten into the popular mind by extensive educational propaganda, the Galton Laboratory for National Eugenics of the University of London, and the Eugenics Record Office of the Carnegie Station for Experimental Evolution at Cold Spring Harbor, Long Island, have embarked on programs of popular as well as scientific education in this matter.

THE PLAY ATTITUDE AND THE SCHOOL FRATERNITY

By Dr. E. L. TALBERT

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IN primitive society men hunted and fought in bands; they planned their expeditions in councils; they celebrated their victories and lamented their defeats in dance, chant and ritual. Boys early left the tutelage of their mothers, and the males—old and young—betook themselves to their "men's houses," lodges or secret societies, from which the women of the tribe were excluded. In some instances women formed like associations, expressing in this way the difference between feminine interests and the more active, predatory tendencies of men.[1]

Whatever the racial origins, the fact is plain that in children to-day there crop out instinctive proclivities to fight, to hunt, to court danger: they form gangs and secret societies in which they play the rôles of primitive man and imitate the occupations of their elders. After the earlier period of romping and playing individualistic games, they find greater delight in group games. At a certain age boys refuse to play girls' games, and separately engage in more violent, complex activities demanding general rules for their successful pursuit. Later, as the characteristics due to sexual ripening grow pronounced, the desire to please the opposite sex enters as a motive. Intricate sports are played with greater efficiency, facility in subordinating individual glory for the sake of the prestige of the team increases. When the physical and mental unrest attending dawning manhood and womanhood arises, vague, deep emotions and ideals are felt, and the occupations which in childhood were "played at" are now considered in the light of possible careers. Gradually the sense of having a mission in the world unfolds, forming one of the bases of religious awakening and interest in history and politics.

A satisfactory account of the phenomena pertaining to the social grouping of childhood and youth should include the following items. (1) It should stress the place of impulses and feelings which are ancestral, conflicting and urgent; recognizing that these impulses ripen at different periods, are roughly uniform, in spite of varying strengths in particular individuals, and that they embody combative and cooperative dispositions, both of which are essential to effective grappling with practical problems. (2) The fundamental requirement of growing organisms is overt activity and experimentation arising from imma-

[1] Webster, "Primitive Secret Societies," Ch. II.

turity and plasticity in the young of the higher animals. To master the details of a changing environment in the more serious after-life, a vast number of physical and mental coordinations must be learned. This experimental balancing of impulses is play. (3) In following out the special motives which may be found to underly play—to be a cause, the desire to create, to dramatize, to "show off"—nature urges the youth into groups, and by means of the give and take of association stimulates sentiment, imagination, leadership and that expansion of self which comes from the consciousness of participating in a group of which each member is a contributing factor and the rules of which the member obeys because he has helped to make them.

It is needless to contend that the puritanical aversion to play, remnants of which are still extant, is evidence of an antiquated psychology and a partial interpretation of morality and education. One of the encouraging indications of recent years is the general willingness to examine the phenomena of childhood and adolescence in a scientific manner without the bias of a total-depravity doctrine or the opposite dogma of the unconditional goodness of natural impulses. The real problem is now seen to be that of knowing the facts and of directing the raw material of youthful activities in a wholesome way. A resultant of the changed attitude is a keener perception of the claims of childhood outside the conventional fields of kindergarten and school—in the street, in the department store, in the factory, and in the scores of juvenile employments which are annually entered by children leaving the elementary schools. By following the lead of Groos and other writers we can appreciate the implications of the forces which urge boys and girls to play house, soldier and conductor, to build "shacks," or to guard the grocery-corner for the exclusive nightly meetings of "the bunch." If the suggestion of the evolutionists is valid, that the baseball is a rounded missile whose progenitor was the more deadly arrow or spear, we can understand the popularity of the national sport. We can realize the possibilities which are implicit in the rivalries and emulations between gangs from different neighborhoods; and why, if there are no provisions for the safe overflow of the play impulses in a city made for adults and manufacture, trade, and other solemn "business," the legitimate desires of youth will turn to the harmful practises of outwitting the policeman, collecting stolen goods, or imitating the exciting career of the outlaw.

A second consequence of the investigation of play from the genetic standpoint is a keen awakening to the necessity of channeling the imaginative, enthusiastic energies of youth by organizing clubs, scouts and playgrounds under municipal supervision. The capital invested in social centers and playgrounds is the objective testimony to a new direction of public conscience and will. An expression of the public judg-

ment in regard to the offices of the play attitude is conveniently given in the Proceedings of the Third Annual Congress of the Playground Association of America:

1. Playgrounds to be effective must have supervisors, directors and teachers who have had such training that they understand the child and can direct his activities so as to bring about the best results mentally, morally, physically and socially.

2. Play, being the chief activity of children during infancy, contains the beginnings of all subsequent development and culture. Its function is educative, and its forms are derived from hereditary adaptations and coordinations pleasurable to us from their usefulness in the distant past of the race. We consider the chief purposes of the playground to be: (*a*) the promotion of robust health through the encouragement of a free and enjoyable life in the open air; (*b*) the development of nervous coordinations and the normal functions, especially of the vital organs, through the vigorous activity of play; (*c*) the arousing of deeper interests, emotions and enthusiasms through those activities by which the central nervous system was developed in the past of the race and to which alone it responds with full effectiveness; thus determining the energy of nervous discharge and consequent vigor of all after life; (*d*) the training in courtesy and good fellowship through those social relations of play in which friendships are chiefly formed; (*e*) the establishment of a moral trend to life through the cultivation of right habits and those loyalties on which social morality and good citizenship chiefly depend; (*f*) the cultivation of a sense of the joy of life, by which the soul is harmonized and unified and a play spirit for life's work is acquired.[2]

As to the specific qualities generated in the play group, we may repeat the conclusions of all who have looked into the matter—that the playground is a field of discipline in the elementary virtues of a democracy: loyalty, sensitivity to fair dealing, and the capacity to lead and to follow under the control of standards applicable to every one in the group. How the boy, in playing a game, puts himself in the other's place and enlarges his range of sympathy and imagery is acutely described by Joseph Lee:

The team and the plays that it executes are present in a very vivid form to his consciousness. His conscious individuality is more thoroughly lost in the sense of membership than perhaps it ever becomes in any other way. So that the sheer experience of citizenship in the simplest and essential form—of a sharing in a public consciousness, of having the social organization present as a controlling ideal in your heart—is very intense. . . .

Along with the sense of the team as a mechanical instrument, and unseparated from it in the boy's mind, is the consciousness of it as the embodiment of a common purpose. There is in team play a very intimate experience of the ways in which such a purpose is built up and made effective. You feel, though without analysis, the subtle ways in which a single strong character breaks out the road ahead and gives confidence to the rest to follow; how the creative power of one ardent imagination, bravely sustained, makes possible the putting through of the play as he conceives it. You feel to the marrow of your bones how each loyal member contributes to the salvation of all the others by holding the conception

[2] Proceedings of the Third Annual Congress of the Playground Association of America, pp. 92–93.

of the whole play so firmly in his mind as to enable them to hold it, and to participate in his single-minded determination to see it carried out. You have intimate experience of the ways in which individual members contribute to the team and of how the team, in turn, builds up their spiritual nature. . . .

It is one thing to be able to feel the swing and unity of a company marching or wheeling on a level floor; it is a very different thing to retain your sense of organization when there is a tangle of bushes or a stone wall between you and the next man on your right. . . . The triumph of the trained imagination in still holding its sense of organization under such circumstances is a notable one; especially when, as in the most successful teams, the player's grasp of the whole movement is of so masterly and flexible a nature as to be adequate not merely to carrying out a prearranged manœuvre in a rigid and unadaptable form, but to sharing with the other members of the team in the intuitive perception of such modifications as may be required by instant and unforeseen emergency.

And the team is not only an extension of the player's consciousness; it is a part of his personality. His participation has deepened from cooperation to membership. Not only is he now a part of the team, but the team is a part of him.[3]

But the social consciousness of the gang and the team has the defects of its virtues. Intelligence and adaptability may be stimulated when boys of widely differing social strata and races meet on a common footing and learn a meaning of equality which is not incompatible with assertion of individual abilities. Nevertheless, the closeness of contact and the powerful emotional appeal may induce a narrow corporate egotism sustained by uncritical custom and the hardening process which attends all institutions. Neighborhood and school may become demoralized by in-grown associations which resist all attempts to harmonize the ends of the small groups with the rights of the community. To preserve the legitimate function of primary groups and at the same time to connect them with the legitimate activities of institutions possessing wider outlooks is a problem confronting secondary schools and colleges. If the process of carrying over the attitudes built up in family and playground, of modifying and redirecting spontaneous impulses, is not done in the school, there is little guarantee that corporate loyalty, so valuable in itself, shall enter into the larger loyalties to the city and the nation.

The general difficulty, therefore, which the school has to meet is to utilize the socializing forces which seek expression in gangs, clubs and fraternities, and to eliminate harmful secrecy and clannishness. The question of fraternities in secondary schools (to which the present discussion is confined) is important because the fraternity is a type of relatively advanced associations arising when a degree of intelligence and ability to discriminate has appeared, when groups are not merely taken for granted, as they were in the period of childhood. Play in

[3] Joseph Lee, "Play as a School of the Citizen, Charities and the Commons," August 3, 1907, pp. 489–490.

early years has reference to immediate ends: as appreciation of the claims of other persons intensifies in adolescence, all pursuits can be interrogated from the standpoint of their consequences. The individual and his group can be recognized to be players in a complicated drama.

Without venturing dogmatic judgments, a few considerations to be taken into account may be outlined. If we adhere to the principles underlying American democracy, it may be asserted that in a progressive society every institution must demonstrate its right to continue by its fruits; that, on the whole, the claims of the community within which a group exists is superior to the corporate demands of the smaller group. The fraternity is one outlet of natural desires for companionship; it expresses the tendency of the like-minded to unite for forwarding their purposes: but whether the fraternity is a help or a drag is to be determined according to the same standards which decide the right to persist of any other group—family, school or political party. The queries to put to it are: Is the group open to others who are fit? Is the basis for selecting members a worthy one? Does this purpose conduce to petty rivalry or to catholicity? Is there a rule of custom which can not be reconciled with the function and public opinion of the whole school? After long experience with the workings of fraternities and sororities in secondary schools, Dr. Owen writes:

> It is idle to object to them that they are selfish and inadequate, when we remember that they are creations of young and inexperienced children. It is equally idle to declaim against them unless we can provide some other system that will do for all what they do for some. I am strongly opposed to the fraternity system in our schools, but I hope I am not bigoted on the question. My fundamental and single objection to them is the fact that they organize the school on a social basis that is narrow and selfish. I can conceive, however, of a social organization of the school in which they might possibly be of but little significance. But as long as the life of the school is what it now is, they serve but to emphasize our neglect. I can appreciate the theoretical defense made in their behalf by a culture-epoch theory of history. The simple fact is that they stand in the way of a social organization of the school that shall provide for all free expressions to social instinct, controlled development of social power, and a happy enjoyment of the society of one's fellows. The best way to deal with the school fraternity is to beat it at its own game.[4]

The specific means of attaining the "controlled development of social power" comprise all those reorganizations of outlook, method, curriculum and "uses of the school plant" which have engaged the attention of educators in recent years. In spite of considerable consensus of judgment regarding the relation of school to society, much remains to be accomplished. After years of discussion it is still pertinent to state that the work of making the secondary school a genuine

[4] W. B. Owen, "Social Education through the School," *The School Review*, Vol. 15, pp. 23–24.

community is not that of creation out of nothing, but of extending and correlating social tendencies already operating; that the problem of assimilating the non-social factions in the school is not one of mechanical adjustment and stricter discipline. If the school as a group is to compete with the narrower loyalties aroused by clique and fraternity it must stand in the minds of teachers, parents and students, for intense, live and big purposes—racial, occupational and civic. It must supply on a large scale the values which exist in small compass in the fraternity. Otherwise the school itself may become an ingrown institution, and its student-government devices, its festivals and athletics for all, its swimming pools and dancing, its football fields and club houses, may become agencies of personal enjoyment outside the correctives of the moral and civic needs of the environing society.

The problem of the fraternity, consequently, is not to be settled by repression or arbitrary enactment. Its solution involves a progressive extension of the play attitude from gang to school and beyond—a play attitude which recognizes responsibility for more and more remote ends and abolishes the time-honored dualism of work and play. For the spirit of the creative artist is not confined to the fields of music, painting and the drama. In the professions, in industry and in politics, the men and women who have caught the contagion of play in their youth make their ideal enterprises enthusiastic, daring games, guided, however, by the standards of execution which they have learned on the playground.

WAGES AND SALARIES IN ORGANIZED INDUSTRY

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I. The Narrowed Range of Information

THE extreme differences between the various groups of gainfully employed people in the United States take from the term "employed" any fixed meaning. Occupation, sex, geographical district and the kind of industry, play havoc with any hope that the problem of service income might be reduced to simple terms and treated as a unit. It is manifestly impossible to look upon a man who is "gainfully employed" as having any particular income, since there is no fixed relation between the fact of employment and the amount of income which employment yields.

Any treatment of service income limits itself arbitrarily because of the lack of available facts. Professional people, people rendering personal services, and the small owner or independent producer necessarily are eliminated. Those engaged in personal service and professional work are gainfully employed in every real sense of the word; the small producer of flour, as an example, is a producer in the same sense that the employees in a great flour mill are producers. At the present juncture, income figures have been collected for none of these groups. All of them perform useful social functions, yet regarding them there is only meager information, and that, for the most part, of so unreliable a character as to preclude the possibility of its use in any study that purports to be scientific.

The data at hand do furnish an indication, though an incomplete one, of the way in which income is apportioned among that vastly important part of the gainfully occupied world which is engaged with the processes of organized industry. After all, it is in them that the most permanent interest must center. Outside of agriculture, they constitute the great majority of the population. They are the human part of that system of organized industry toward which the world seems to be moving; from their hands flows most of that stream of goods upon which society subsists; to them is committed the imperative task of feeding, clothing, housing and otherwise providing for the wants of mankind. Although agriculture can not be included in the analysis because of the extreme paucity of the information about agricultural income, nevertheless the data about organized industry are profoundly significant because they bespeak the income situation in the newest, and it is probably fair to say the coming form of industrial organization.

"Values to the extent of $100 are paid to 'labor' or in the form of 'compensation' or of 'wages and salaries.' How is this $100 actually divided up among those who participated in its production?" The answer to that question can not as yet be made final; to the careful searcher after truth it is far from satisfactory; yet those who have eyes to see will find in it many suggestions of the situation that will stand revealed when all of the facts in the case are made available for study.

The tentative answer as to the disposition of service income will indicate for the various classes of industries what the situation of the ordinary, or "modal," person is. Of course the answer will not cover individual cases. No general statement holds true of individual instances. It will, however, show for certain occupations the general scale of service incomes.

No one can overstate the danger of trying to deduce from a statement of averages, or other general ideas referring to a class of things or persons, the condition of individuals in that class. It does not follow because the average for machinists on a certain railroad is $1.90 per day that the machinists on that road all receive $1.90 per day. It does not even follow that any one machinist is receiving exactly $1.90 per day. Some are receiving more, and some less. The mathematical computation derived from these individual rates of daily wages yields the average, $1.90.

The average is, at best, a crude method for the statement of incomes. Convenient because of ease in handling, it is misleading in the extreme when employed for purposes of generalization. It bespeaks not instances, or laborers, or families, but abstract deductions from the relation existing between these highly humanized economic facts.

The classified wage is far more satisfactory as a method of statement than is the average wage. Instead of averaging the wages of all machinists and stating the result as $1.90, the statement is made in this form: "Of 100 machinists, 5 receive less than $1.50 per day; 12 receive from $1.50 to $1.74; 40 receive from $1.75 to $1.99; 20 receive from $2.00 to $2.24," and so on through the list. The result is a presentation of earners by groups in a way that tells the size of the group and the amount earned by each number. Out of 100, 40 earn from $1.75 to $1.99. That is a very different matter from saying that the average wage is $1.90. If care is taken, generalizations regarding types and tendencies may be made without doing too much violence to individual instances. These generalizations should, wherever possible, be based on classes, rather than on averages.

Classified wage figures do not permit of such ready generalizations. They do, however, decrease error. People have assumed that the steel industry is a very lucrative one because certain individuals have made millions in it, or that there is an abundant chance for rapid advancement in the railroad industry because certain railroad presidents came

up from the ranks. Neither inference is necessarily correct. Generalizations can be made safely only where the facts about the great mass of instances are known. One man has made a million in the steel industry; four fifths of his co-workers in the industry are paid less than $1,000 a year. Is the industry lucrative? One man rose from the ranks to be president of a great railroad system. There are a hundred thousand of his fellows still in the ranks. How much chance have these men to become president of the railroad? The time has come to cease crude generalizations, and, by an appeal to the facts, to discover, not the average, but the actual way in which service income is distributed among gainfully employed people.

The races of men always face the statistician with the stern demand that he render a quick, easily comprehensible generalization, even though it be from a few insufficient instances. "Be brief" is a dangerous behest for science to follow. It leads to falsehood and inexactness more often than it leads to truth. It often happens that the statistician must sacrifice brevity for the sake of accuracy.

II. Salaries and Wages

The first large fact encountered in the analysis of service income is the distinction between salaries and wages. Although this distinction is arbitrary, it is significant for two reasons. First, because the incomes of "officers" and "salaried employees" are often very much higher than the incomes of "wage-earners"; and second, because in a large number of important publications dealing with service income, the incomes of wage-earners alone are given, while in other cases the figures frequently contain statements for salaries and wages. In the main, the emphasis will be laid upon wages, first, as a matter of necessity. There is no analysis of compensation which shows salaries with the same minuteness that wages are set forth. Secondly, as a matter of choice. The wage-earners, being an overwhelming majority of the whole, constitute the bulk of the human income problem in industry.

The contrast between the amount paid to salary-earners and to wage-earners is in some cases considerable, and in others it is far less marked. Average figures alone are available for this comparison, because there is nowhere any statement of classified earnings for "officers." Although crude in the extreme, these averages give some idea of the divergence between "salaries" and "wages."

The Iowa Railroad Commission reports several instances in which the compensation paid to officers is not much greater than that paid to wage-earners. The general officers of the Iowa Terminal Companies[1] receive an average daily compensation for one company of $7.67, and for another company $4.38, while for the same companies the average

[1] Annual Report of the Board of Railroad Commissioners of Iowa, 1911, Des Moines, 1913, p. 498.

daily compensation of all other employees ranges from $1.95 to $2.55. The Iowa Bridge Companies[2] report an average daily compensation for general officers of $4.32, and for all other employees $2.01. These companies are small, and the variation between the returns to the officers and wage-earners is probably typical of that existing in many small businesses.

The railroads report a divergence between the compensation of general officers and of other employees which is considerable. For all operating railroads in the United States, the average daily compensation of general officers was $12.99[3] For Class I. roads (annual earnings over $1,000,000) the average is, in the Eastern District, $19.52; in the Southern District, $14.63; and in the Western, $16.63. In Class II. and Class III. roads the average is much lower. "The other officers" (there were in 1911 5,628 "general officers" and 10,196 "other officers" on all operating roads) received an average daily compensation of $6.27. For Class I. roads the average, as before, was somewhat higher than for Class II. and III. roads. Although the compensation rates for "other officers" do not greatly exceed the rates for the best-paid wage-earners, the rates of pay among general officers is much higher than for the wage-earners. With the exception of enginemen, conductors and machinists, no group of railroad employees receives an average daily compensation of more than $3.00 a day. For conductors and enginemen it is $4.16 and $4.79, respectively, and for machinists, $3.14. For most of the employees the average daily compensation ranges around $2.00. The same relation exists between the average wage of the great bulk of railroad employees and that of "other officers" as that shown for the Iowa Terminal and Bridge Companies. The compensation of the "general officers" on the railroads is very much higher.

Although the facts are most readily usable in the railroad industry, an examination of the figures from street and electric railways, mines and quarries, telegraph and telephone companies, and manufacturing industries tends to confirm the general impression made by the railroad statistics. For small concerns, and for second-grade officers, the rate of return is not greatly in excess of the rate for the better-paid wage-earners. The general, or first-class, officers who are responsible for large enterprises do receive, as a group, a rate of return which is ordinarily from five to ten times greater than the rate paid to wage-earners.

There is another point of great significance which must be borne in mind in this connection. The salaries of general officers are high in individual instances, nevertheless the aggregate of salaries paid is

[2] *Ibid.*, p. 516.

[3] Statistics of the Railways of the United States, 1911, Interstate Commerce Commission, Washington, Government Printing Office, 1913, p. 28.

small as compared with the entire amount of service income. Thus on the railroads the total compensation of both general and other officers was $40,000,000 in 1911. This constituted only about 3 per cent. of the total compensation paid during the year to all classes of employees. If to the salaries of all officers are added the total salaries of office clerks,[4] the entire salary schedule for the railroads covers 8 per cent. of the total amount paid in compensation.[5] The same situation exists in street railways. All street and electric railway salaries amount to approximately $13,000,000, which is 9 per cent. of the total amount paid for compensation.[6] The Census reports[7] the payment of $4,366,000,000 for services in the manufacturing industries. Of this amount, $939,000,000, or more than a fifth, was expended for salaries. Officers of corporations received a quarter of this salary expenditure; superintendents and managers another quarter, and clerks and other subordinate employees received a half. If individual industries are examined, however, it appears that in highly organized businesses like the production of iron and steel, of railroad cars and locomotives, of agricultural implements, and the like, the relation of salaries to total compensation is essentially the same as that for railroads. The figures for mines and quarries[8] show $40,000,000 paid in all kinds of salaries, as compared with $370,000,000 paid in wages. Again the figures appear as about 10 per cent. General officers received one fifth of the forty millions, or about 2 per cent. of the whole; superintendents, managers and foremen received three fifths, and clerks one fifth of the total salary expenditure. For those industries in which figures are available, it would seem that the general officers receive less than one twentieth of the total amount paid in compensation, while all salaried persons (general officers, other officers and clerks) receive about a tenth of the total payments in the form of compensation. This generalization holds true for large, highly organized industries. In the smaller, less specialized industries, the proportion which the salary account bears to the total payments for compensation is perhaps double that in the larger industries.

The figures furnish an indication of the manner in which service income is divided between those who receive salaries and those who receive wages. When a hundred dollars is paid in compensation by a

[4] This computation is made because of general usage by virtue of which clerks are paid by the month. Their yearly earnings are usually less than those of the better-paid wage-earners.

[5] *Ibid.*, p. 29.

[6] "Street and Electric Railways," 1907, Special Report of the Census, Washington, Goverment Printing Office, 1910, p. 195.

[7] Thirteenth Census of the United States, Volume VIII., Washington, Government Printing Office, 1913, p. 129.

[8] "Mines and Quarries," 1902, Special Report of the United States, Washington, Government Printing Office, 1905, p. 91.

modern large-scale industry, from 3 to 4 dollars go to general officers, from 6 to 10 dollars go to other salaried employees (including clerks), and the great bulk, from 85 to 90 dollars, is paid in the form of wages to wage-earners. This formula will not hold good for individual industries, but it does express with a considerable degree of fairness the situation now existing in organized industry. Furthermore, the fact should not be lost sight of that in more highly organized industries, that is, in the industries which have evolved to the point which virtually all industries may be expected to reach in the process of their development, at least ninety out of every hundred dollars paid for compensation goes in the form of wages.

The point regarding the distribution of compensation among salaried employees and wage-earners is not stressed. For the purpose of this study no importance attaches to the distinction between a wage and a salary, since both payments are made for "services." Nevertheless, since most of the available figures relating to service income are wage figures, the critical reader will bear in mind the fact that the necessity which forced the use of such material bears every earmark of reasonableness, since the bulk of service payments are made in the form of wages.

III. Incomes of Managers, Foremen and Other Officers

The data regarding the apportionment of incomes among officers of all grades are meager in the extreme. The mass of figures cited in the last section give some idea of the general relation existing between "salaries" and "wages" in bulk. They are of no value in an analysis of income apportionment among individual salary and wage-earners.

Figures showing the apportionment of income among general officers are apparently non-existent in any usable form. Even for under officials the figures are so scanty as to be worthy of only the most cursory analysis. The reason for this paucity of data is apparent. On the one hand, several of the most reliable sources (the reports of classified wages in the manufacturing industries of Massachusetts and New Jersey, for example) include "wage-earners" only in their classification. On the other hand, much of the salary information relating to under officials is, for all practical purposes, unclassified. The latest report of the California Bureau of Labor Statistics[9] is an excellent case in point. The income classification in that report includes, in its last category, incomes of $25 per week and over ($1,300 per year). For each city and under each industry "superintendents" or "managers" are listed, but in nine tenths of the instances they fall in this last class. That they receive more than $1,300 per year goes almost without saying. Exactly how much more the report does not state. The report

[9] Biennial Report for 1911–12, Sacramento, 1912.

might have stated with equal validity that the officials in California industries received in nine tenths of the cases over $1,300 annually.

The figures showing the service incomes of inferior officers on the railroads appear in the form of averages only. The section foremen, of whom there were 44,466 in 1911[10] received an average daily compensation of from $1.92 to $2.17, varying with the part of the country in which they were at work. The average daily compensation of general officers ($12.99) and of other officers ($6.27) has already been commented on. Apparently the railroad foremen receive a wage approximately the same as that paid to semi-skilled wage-earners. The compensation paid to officers is considerably greater.

One report[11] contains data of real importance in this connection. The most available figures in this report relate to the Bell Telephone System, from the 1908 pay rolls of which they were taken. Among the Bell employees there were 614 foremen, one fifth of whom received less than $80 per month ($960 per year), and eleven twelfths of whom received less than $125 per month ($1,500 per year). Of the total number, only 51 received more than $125 (the last class appearing in the report). The rates of pay for assistant foremen (39 in all) were much lower. Half fell below $80, and all but one below $125 per month. The pay of general foremen was higher. Of the 21 listed, half (10) received $125 or over per month. The managers and assistant managers were paid at approximately the same rate. Two fifths received less than $80, and four fifths less than $125. The pay of superintendents is much higher. There were only three under $80, and nine under $125. Three fourths (32 out of 41) received $125 or over.

The New York Public Service Commission reports upon the income rates of 635 foremen and assistant foremen employed by gas and electric utilities in the First District of New York. Only 2 per cent. received less than $750; 22 per cent. received less than $1,000; and 58 per cent. received less than $1,250.[12]

These figures are given rather because they emphasize the paucity of the data than because they serve any useful statistical purpose. So far as the figures go, they suggest that foremen, assistant superintendents and assistant managers are paid salaries about equal to those of the best-paid tenth among the wage-earners ($1,000 to $1,500 per year). Superintendents, general superintendents and general managers usually receive more than $1,500. It is to be hoped that before another income study is made there will be some authoritative state-

[10] Statistics of Railways, 1911, *op. cit.*, pp. 26 and 28.

[11] Investigation of Telephone Companies, United States Bureau of Labor, Senate Document 380, 61st Congress, 2d Session, Washington, Government Printing Office, 1910, pp. 273–89.

[12] Report of the Public Service Commission, First District of New York, 1911, Volume III., p. 275.

ment, at least for transportation agencies, showing the classified incomes of the men higher up.

IV. The Income of Clerks

There seems to be no very good reason why clerks should be classed among "salaried employees" rather than among "wage-earners," except that they are paid by the month. Nevertheless, they are so classed in virtually all of the reports, including the Census reports. For that reason they are so treated in this study.

The railroad industry may be passed by with a word of comment, since its figures take the undesirable form of "averages." The general office clerks[13] (30,613 in all) receive average daily compensations of $2.49. The uniformity of their compensation throughout the country is astonishing, in view of the usual variation in wages between the east and the west.[14] In the Eastern District they received $2.56; Southern, $2.39, and Western, $2.44. The other two groups of railway employees whose services might be classed as clerical are station agents (15,309 in 1911), and telegraph operators and dispatchers (14,857 in 1911). Their daily compensation is very uniform with that of the clerks. The average for the United States was: station agents, $2.17, and operators and dispatchers, $2.44. As in the case of the clerks, the rate of compensation varies only slightly from one part of the country to another. Apparently the salary rates of men doing clerical work in the railroad industry lie somewhere between $650 and $900 per year.

The statistics furnished from the telephone industry are worthy of some attention.[15] The total number of male clerks employed by the Bell system was 2,650. Of this number, one tenth received less than $40 per month, one third received less than $60, seven tenths received less than $80, and 52, or about 5 per cent., were paid more than $125. For the 257 male bookkeepers the facts show a slightly lower range. Only three received over $125, while four fifths received less than $80. Apparently in the telephone industry, as represented by the Bell interests, the bulk of the male clerical force is paid from $600 to $1,000 per year.

The female employees of the Bell system who were engaged in the work of clerical grades are compensated at a rate much lower than that for males. A little more than half (1,015) of the 1,862 female clerks were paid less than $40 per month, while nineteen twentieths were paid less than $50. The female "operators," who comprise the great bulk of telephone employees, report similar wages. The telephone company, employing 16,229 operators, paid seven eighths of them less

[13] Statistics of Railways, 1911, *op. cit.*, pp. 26 and 28.

[14] "Wages in the United States," Scott Nearing, New York, Macmillan Co., 1911, Chapter 8.

[15] Investigation of Telephone Companies, *op. cit.*, pp. 273–89.

than $40 per month, and all but 9 of them less than $60 per month. The 377 female stenographers received somewhat higher wages. Only a seventh fell under $40, two thirds under $60, while 19 earned over $80. Most of the female clerical force employed by the Bell system received less than $500 per year. A few were paid more than $700. The Public Service Commission of the First District of New York[16] gives some excellent figures for the public utilities. The street railways employ[17] 423 male general office clerks, for whom the wage rates are under $500 per year in 8 per cent. of the cases, under $750 in a quarter of the cases, and under $1,000 in three quarters of the cases.[18] The wage rates for the gas and electric utilities are very similar. Among 1,515 male clerks and salesmen, half received less than $750, and nine tenths under $1,250. The ratio is similar for other clerical employees. For cashiers and bookkeepers the rate is higher.[19]

The pay of females doing clerical work in all of the New York public utilities is very much lower than that of males. The street railway general office clerks receive less than $750 in four fifths of the cases. Among the 252 clerks and salesmen employed by the gas and electric companies, 210 received less than $750, and 240 less than $1,000 a year. The rate for stenographers and typists is somewhat higher, one in ten of them receiving over $1,000 a year.

Little information is available dealing with the salaries of clerks in manufacturing industries. The Census reports the employment in the manufacturing industries of 576,356 "clerks and other subordinate salaried employees."[20] The total salaries paid to this group was $497,998,101.[21] The absence of any statement regarding sex invalidates any analysis of the figures.

The female clerical help employed in Washington, D. C., in de-

[16] Annual Report of the Public Service Commission of New York, First District, 1911, Volume II.

[17] For convenience of comparison, the figures given in the remainder of this study are stated, for the most part, in the following classification:

Per Cent. of Persons Receiving Wage Rates Per Year of Less Than

$250	$500	$750	$1,000

The percentage basis is substituted for the numerical basis because it results in greater clearness. The classification per year rather than month, week, or day, is adopted, because the figures appearing in the reports as rates per hour, day, week and year, can be reduced to a rate per year more readily than to any other rate. Observe that these figures do not represent earnings per year. No allowance is made for unemployment in any of its forms. The rate per week or per month is multiplied by 52, or by 12, in order to give a year rate. The reduction of all of the figures to a common basis militates somewhat against their accuracy (as when a per hour rate is converted into a yearly rate), but adds greatly to their clearness.

[18] *Ibid.*, p. 334.

[19] *Ibid.*, pp. 272–74.

[21] *Ibid.*, p. 129.

[20] General Report on Manufactures, Thirteenth Census, Volume VIII., p. 239.

partment stores (252 in all) received in a fifth of the instances less than $250 per year, and in four fifths of the instances less than $500 per year.[22]

Although these figures showing the wage rates of clerks are meager in the extreme, they are sufficiently extensive to permit of a tabular statement that will bring out the likenesses and differences existing among them.

TABLE I

SALARY RATES OF MALE CLERKS IN CERTAIN INDUSTRIES

Industry and Occupation	Total Number Employed	Per Cent. of Male Clerks Receiving Wage Rates per Year of Less Than			
		$500	$750	$1,000	$1,250
Bell Telephone System (clerks)	2,650	9	36	71	95
New York Street Railway (general office clerks)	423	8	27	74	......
New York Gas and Electric Utilities (clerks and salesmen)	1,515	9	47	76	91
Other clerical employees	440	22	57	85	93
Cashiers and bookkeepers	587	2	5	48	83

TABLE II

SALARY RATES OF FEMALE CLERKS IN CERTAIN INDUSTRIES

Industry and Occupation	Total Number Employed	Per Cent. of Female Clerks Receiving Wage Rates Per Year of Less Than		
		$500	$750	$1,000
Telephone clerks	1,852	54	95	99
Telephone operators	16,129	87	99	......
Stenographers	377	13	60	96
New York Street Railway	154	66	85	99
New York Gas and Electric Utilities (clerks and saleswomen)	252	29	83	95
Stenographers and typists	209	14	59	89
Washington department stores	252	23	82	......

Those clerical occupations for which data are available pay wages at a rate that does not differ materially from the ordinary wage rates of semi-skilled and skilled labor. Three quarters of the male clerks receive less than $1,000 per year, while less than 10 per cent. are paid more than $1,250. For females the rates are much lower. The proportion of women who receive less than $750 for clerical work is approximately the same as the proportion of men who receive less than $1,250. The woman in a clerical position who receives more than $1,000 is the exception, just as the man who receives less than $500 is the exception. At the same time, a large percentage of the women receive less than this figure, while a considerable proportion of the men receive more than $1,000. In only a small proportion of the instances

[22] "Hours, Earnings and Employment of Wage Earning Women in the District of Columbia," United States Department of Labor, Bulletin 116, Washington, Government Printing Office, 1913, pp. 22 and 23.

does the wage rate among male clerks rise above $1,250; in an even smaller number of instances do wage rates of female clerks rise above $750.

V. The Income of Wage-earners in Transportation and Commerce

One of the most unsatisfactory situations which an analysis of wage statistics reveals, is the paucity of the wage figures relating to transportation and commerce. It is in these fields that inquisitorial bodies have the greatest authority; yet it is in these fields, strangely enough, that the wage statistics are least satisfactory. With the exception of the Census volumes for 1912 on express, and telephone and telegraph, and of a special report by the Bureau of Labor on the telephone industry, there is little or nothing of note.

The wages in the railroad industry, employing as it does more than a million and a half persons, are stated only as averages. The excuse for this statement of railroad wages in terms of averages—it requires some excuse, for, though the averages are given by districts and for ten wage-earning occupations and two groups of miscellaneous wage-earners, these again classified by districts and by the class of railroads, they are still averages, and therefore suffer under all of the disqualifications that averages are heir to—seems to be that the length of time and the conditions of the work done by different employees vary so greatly that no classified statement could do justice to the situation. Pursuant of such philosophy the Interstate Commerce Commission has done, under the circumstances, the most misleading thing that it could possibly have done—that is, it has published averages; and the State Railroad Commissions, following the footsteps which, unknown to them, led so directly into this statistical quagmire, also have published nothing but averages.

Granted that, in the case of railroad employees, the classified or group system of stating wages is inaccurate, how much more inaccurate does the average become? Instead of accepting errors at their face value, the average thus obtained compounds and augments error. Nor is this a case in which errors tend to neutralize each other. What avails an average of the wages of switch tenders in Maine and in Ohio? What avails an average wage for "all other employees and laborers," including for the United States nearly a third of a million men? The method carries its own refutation. Except as a basis of comparison from year to year, the figures are meaningless and absurd.

The difficulties lying in the path of obtaining classified wages for railroad employees do not seem to be so great as the protestors claim them to be. Why should not the Interstate Commerce Commission secure from each railroad a statement for the first week in June and December showing the number of employees of each class who had

earned during that week less than $5, $5 but less than $6, $6 but less than $7, $7 but less than $8, and so on through the category? If the system of payment by months is so prevalent as to make the weekly statement impossible, a statement for an entire month would be even more satisfactory than a statement for a week only. The time would be longer and the results more representative.

At this point it must suffice to say that the average figures for wages on American railroads seem, for the most part, typical of the average wages reported in the manufacturing and other like industries. With the exception of enginemen, conductors and machinists (who constitute 9 per cent. of the total number of employees, and whose wages average in the first two cases over $4, and in the last over $3), no group of employees reports an average wage of more than $3. For three groups the average is less than $2; for three groups it is between $2 and $2.49, and for three other groups it falls between $2.50 and $2.99. An analysis of average wages in those manufacturing industries which are similar in character to the work done on the railroad, shows that the averages are approximately similar.[23] With the exception of the three high-paid occupations mentioned above, railroad wages are, to all appearances, on a level with other wages in the community.

The telephone and telegraph industry offers some excellent wage data. The Oklahoma Department of Labor publishes some figures on wages in the telephone industry. Of 660 male wage-earners, 27 per cent. received less than $500; 78 per cent., less than $750, and 95 per cent. less than $1,000. The wage rates for females are much lower. There were 1,143 employed. The wage rates of 17 per cent. were under $250, 96 per cent. under $500, and 99 per cent. under $750.[24]

The wage figures published by the Bureau of Labor[25] are taken from the pay rolls of the company, and represent, as accurately as wage figures may, the situation on the company's books in 1908. In general, the wage scale in the telephone industry is much higher than the scale in most other industries.[26] The wages in nine typical occupations (cable splicers, chauffeurs, drivers and stablemen, installers, inspectors, laborers, repairmen, switchboard men, testers and trouble men) show a considerable uniformity.[27] Only 10 men (they were all in one class, "inspectors") were receiving wages of more than $125 per month ($1,500 per year); two fifths received less than $750; four fifths received less than $1,000. If the laborers are eliminated, the range for the other occupations is greatly advanced. The great bulk of installers,

[23] "Wages in the United States," *op. cit.*, Chapter 7 and Chapter 9, Section II.

[24] Annual Report of the Department of Labor of Oklahoma, 1911–12, p. 232.

[25] Investigation of Telephone Companies, 1910, *op. cit.*

[26] "Wages in the United States," *op. cit.*, pp. 96–108.

[27] Investigation of Telephone Companies, *op. cit.*, pp. 273–289.

inspectors, repairman, switchboard men, testers and trouble men earn from $750 to $1,000.

The figures for transportation and commerce permit of no further generalization than this—so far as the data at hand may be relied upon, those occupations which have counterparts in manufacturing industries apparently pay about the same rate of wages. At the same time, there are in this field a number of highly skilled occupations which pay wages far above the usual run of wage rates. Even in these high-paid occupations, however, only a small proportion of male employees receive over $1,000; about an equal proportion of female employees receive over $750. Here and there a male employee is paid over $1,500 per year, and a female employee over $1,000 per year. These cases are so rare as to be unique.

VI. The Income of Wage-earners in the Mercantile Industry

The wage figures for the mercantile industry are even less conclusive than those for transportation and commerce. Their inconclusiveness has far more excuse for existence, however. Until recently the mercantile industry has been conducted on a small scale. The individual proprietor is still the dominating force in many fields. In no sense have the mercantile trades been organized as the railroads and the steel industry are organized. At the same time, organization is becoming the rule of the road, and the mercantile industry is rapidly shaping itself into a highly developed business. Meanwhile, the meager data on wages in the mercantile houses are indicative, though not in any sense conclusive.

The last report from California gives in elaborate detail the facts regarding the wholesale and retail mercantile establishments.[28] Although the figures are scattering, a summary for San Francisco and Los Angeles (the two chief mercantile centers) gives the following results for male employees.

The contrast between the wages of males and of females is sharp indeed. While only a tenth of the males receive less than $500 per year, and only a third less than $750, a tenth of the females in retail establishments receive less than $250; from a fifth to two fifths receive less than $500; and from three fifths to four fifths fall under $750.

The wage rates for both sexes are higher in wholesale than they are in retail establishments. This is more true in the case of males than of females, although it is striking in both instances. It is also interesting to observe that the wage rates in San Francisco do not differ materially from those of Los Angeles.[28a]

[28] Biennial Report for 1911–12, Sacramento, 1912. Figures compiled from the tables.

[28a] The reader should bear in mind the fact that wages in California are perhaps a fifth or a fourth higher than wages for corresponding occupations in the East.

TABLE III

WAGE RATES OF MALES, CALIFORNIA, 1911

Retail Establishments

	Total Employed	Per Cent. of Employees Earning Wage Rates Per Year Less Than			
		\$250	\$500	\$750	\$1,000
San Francisco..............	5,389	4	14	29	57
Los Angeles................	6,277	3	10	37	71

Wholesale Establishments, Males

	Total Employed	Per Cent. of Employees Earning Wage Rates Per Year Less Than			
		\$250	\$500	\$750	\$1,000
San Francisco..............	8,300	1	7	23	52
Los Angeles................	4,820	....	6	29	51

The Massachusetts Commission on Minimum Wage Boards reports on the wages of 3,761 women and on the annual earnings of 1,533 who were employed throughout the year. Many of the department-store employees not employed throughout the year leave for new positions, or are laid off in the dull season. All but 33 of the 1,533 women employed throughout the year earned less than \$500 per year. The hour rates of all of the 3,761 women show practically the same ratio.

Two other sources of information yield similar results. A well-made study of saleswomen and other mercantile employees, not including buyers or clerical assistants, was made in Baltimore by Elizabeth B. Butler. The total number of women covered by the investigation was 4,048. Of these women, 2,184, or 54 per cent., received a rate of pay of less than \$250 per year, while 95 per cent. were paid less than \$500.[29] These rates are apparently slightly below the rates in Washington. Among 1,760 saleswomen in the Washington stores, a quarter received less than \$250, while less than nine tenths fell below \$500.[30] Comparative studies indicate that the department store employees are paid at a higher rate than factory employees. Unfortunately the variations of age between the two occupations have not generally been taken into account. An Illinois investigation covering 2,556 department store employees showed that a twentieth received less than a \$250 wage rate, and half less than a \$500 year rate. On the other hand, a fifth of the wage rates were over \$750.[31]

It seems evident that for most saleswomen in eastern mercantile

[29] "Saleswomen in Mercantile Stores," E. B. Butler, Baltimore, 1909, New York, Charities Publication Committee, 1912.

[30] "Hours, Earnings and Employment of Wage-earning Women in the District of Columbia," *op. cit.*, pp. 22 and 23.

[31] Biennial Report of the Bureau of Labor Statistics, Ill., 1908, Springfield, 1910, pp. 413–592.

stores, wage rates of more than $500 per year ($10 per week) are out of the question. The great bulk of them are paid from $250 to $500.

VII. The Incomes of Wage-Earners in Certain Manufacturing Industries

Whatever their failure to provide adequate statistics covering wages in other gainful occupations, state and federal authorities have vied with one another in their efforts to prepare wage statistics for the manufacturing industries. The figures are as yet far from complete; there are still many loopholes through which unjustifiable conclusions may slip unaware; yet, all things considered, the wage figures for the manufacturing industries are far superior to those for other occupations. They point the way, showing what may be done in the compilation of wage data.

Convenience leads to a grouping of the figures for manufacturing industries into three classes. Those for special industries, such as steel, textiles, etc.; and those for certain states which publish the best wage statistics; and those published by the Census.

The past three years have added materially to the statistics for special industries. The public demand for facts which arose out of labor disturbances, and the activity of certain public commissions vested with inquisitorial power, have led to the collection of considerable wage data of the greatest value. These data are peculiarly important because in many cases the investigation has been made from the pay rolls of the company or industry in question. In certain cases these pay-roll data have been extensively compared with pay envelopes. The purpose of this section will be served by a review of only the most important of the recent wage investigations.

The most complete, and in all ways the most satisfactory, of the recent studies is that of the iron and steel industry, appearing in four volumes.[32] Each occupation in the steel industry was carefully studied. The investigation included plants in every part of the country, and was minute and painstaking in the last degree. In so far as the wage figures are important at this point, they may be briefy summarized as follows: The investigation covered 172,706 employees; their wage rates per year (computed from the per hour rates given for May, 1910) were, under $500, 8 per cent.; under $750, 60 per cent.; under $1,000, 85 per cent.; and under $1,500, 97 per cent.[33] These rates are somewhat higher than the rates previously derived for Bethlehem,[34] where the wage rates for

[32] Report on Conditions of Employment in the Iron and Steel Industry in the United States in four volumes, 62d Congress, 1st Session, Senate Document 110, Washington, Government Printing Office, 1912.

[33] Summary of Wages and Hours of Labor in the Iron and Steel Industry, United States Department of Labor, Senate Document 301, 62d Congress, 2d Session, Washington, Government Printing Office, 1912.

[34] "Wages in the United States," *op. cit.*, pp. 108–112.

that one plant were (January, 1910) in a third of the instances less than $500 per year, in two thirds of the instances less than $625, and in only 8 per cent. of the instances $1,000 and over. In explaining this difference allowance must be made for the fact that the Bethlehem works are in a small city, while many of the plants are located in great centers of population.

Although the wages in the iron and steel industry are higher than the wages paid in many American industries, they seem fairly representative of the situation in those branches of manufacturing which afford employment to men only. In the industry where women as well as men are employed, the wage scale is lower. The wage formula for the steel industry may be taken as a representative of the man-employing industries.

Labor troubles and tariff controversies have combined to attract public attention to the wage rates paid in the textile industries, consequently the data for these industries are now fairly well authenticated. The Tariff Board made an extensive investigation of wage rates in the cotton industry.[35] The information, secured from 76 establishments, covered 18.67 per cent. of all cotton spinning and weaving employees enumerated by the Census (p. 633). An arbitrary division between the northern and southern mills draws a line of marked distinction as to wages. Among the males sixteen years of age and over, in the north 5 per cent., and in the south 22 per cent., received a wage of less than $250. Half of the northern men and over four fifths of the southern men were paid at a rate of less than $500 per year. The highest wage rate in the schedule was twenty-eight cents per hour (about $750 per year). In the north 6 per cent., and in the south 3 per cent., earned more than this amount. The figures for women range much lower than the figures for men. The highest class in the women's schedule is eighteen cents per hour (about $500 per year). In the north, one fifth, and in the south, two per cent., receive more than this amount.

These rates for the cotton industry are similar to those for the woolen and worsted industry. The Tariff Board reports for dyeing and finishing woolens and worsteds[36] that the wages of male dyers are in four fifths of the cases under $500, and in nine tenths of the cases under $700. The highest wage class given in this schedule is twenty-five cents per hour (about $700 per year). Eight per cent. of the male dyers, 15 per cent. of the male finishers, and 3 per cent. of the female finishers received wage rates above that amount. This investigation is obviously faulty in the comparatively small proportion of the employees

[35] Report of the Tariff Board on Cotton Manufactures, 62d Congress, 2d Session, House Document 643, Washington, Government Printing Office, 1912, Volume II., pp. 637–651.

[36] Report of the Tariff Board on Schedule K, House Document 342, Washington, Government Printing Office, 1912, Volume II., pp. 810–811.

included. It is suggestive, however; and corroborated as it is by the records of other investigations, it must go almost unchallenged.

The report on the wages in the woolen, worsted and cotton mills of Lawrence, Mass.,[37] (November, 1911) is corroborative, for one town, of the general situation as suggested by the Tariff Board's general report. Half of the men received a wage rate of less than $500; seven eighths, of less than $600. More than four fifths of the women fell in the group under $500, and 94 per cent. received less than $600. The schedule grouped all earnings above $600 in one class. These figures represent the actual earnings of males and females eighteen years of age and over during one month in 1911.

Similar wages were compiled for the textile mills (largely hosiery mills) of Little Falls, N. Y.[38] These figures represent actual earnings during parts of September, 1912. Among the total of males employed, three fifths earned at the rate of less than $500, while nine tenths earned at the rate of less than $750 per year. Of the 2,736 women, 99.8 per cent. earned at the rate of less than $750 per year, while three quarters fell below $500. This period under investigation is described by the report as one of normal working conditions.

The inferences from these figures for special towns are corroborated, in large measure, by the special publication of the United States Department of Labor, dealing with the textile industry. These figures, while incomplete and open to question because of the uncertainty as to the manner in which the factories and employments under consideration were selected, are nevertheless suggestive of the general situation. In the cotton industry, three fifths of the males, and four fifths of the females received wage rates of $500 per year; while 97 per cent. of the males. and 99 per cent. of the females had wage rates of less than $750 per year.[39] The wage rates in the woolen industry are considerably higher, though at about the same level as that for the special reports. The wage rates reported for the textile industries in Massachusetts and New Jersey amply confirm the results derived in these special investigations.

The textile industries show an unusually low scale. Practically none of the men receive more than $1,000; with the exception of woolen finishers, only a tenth receive more than $750. Among the women the rates are even lower. For them a wage over $750 is not

[37] Report on the Strike of Textile Workers in Lawrence, Mass., Charles P. Neill, Senate Document 870, 62d Congress, 2d Session, Washington, Government Printing Office, 1912.

[38] "The Little Falls Textile Dispute," New York State Department of Labor, Advance Report of the Bulletin for March, 1913, Albany, 1913, pp. 10–11.

[39] "Wages and Hours of Labor in the Cotton, Woolen and Silk Industries," United States Department of Labor, Bulletin 128, Washington, Government Printing Office, 1913, pp. 30–34.

found much oftener than once in a hundred times, while a wage of less than $500 is paid in three fourths or four fifths of the cases.

Although so many data have been compiled for textiles, the other industries have not been neglected. A number of wage figures are available for lumber and kindred industries. The Tariff Board published a report on the wages for certain selected occupations in the paper industry,[40] and the Bureau of Labor has a study of wages in the lumber and furniture industries. The men employed in the paper industry receive rates of less than $750 in four fifths of the instances, and of less than $1,000 in nineteen twentieths of the instances. The wage rates in the lumber, millwork, and furniture industries are approximately the same as those for pulp and paper, although lumber falls lower than either of the other two. Two fifths of the men in the lumber industry receive less than $500 per year; nine tenths receive less than $750. Millworkers receive less than $750 in three fifths of the cases, and less than $1,000 in three fourths; while furniture makers (male) receive less than $750 in half of the cases, and less than $1,000 in nine tenths of the cases.

The data presented by the Department of Labor for the clothing industry are so meager as to be almost unusable. The total number of persons included in the statement is six thousand women, and seven thousand men.[41] Since there is no certainty as to the manner in which the selection was made, and since there is little or no corroborating evidence, the material must be passed over.

The study of wages in the cigar industry, which the Department presents, is somewhat more illuminating, because it is more careful and detailed.[42] Still, the number of employees for whom evidence is submitted is woefully small. Among the 3,615 males, three tenths received a wage of less than $750, and half a wage under $1,000. Four fifths of the 7,551 females received less than $750. Any one who takes the pains to examine these figures can not help feeling that they do not adequately represent the cigar industry.

An interesting analysis of the work of women in the finishing department of the glass industry appeared in connection with the study of "Woman and Child Wage-Earners." The study, which covered the glass industry with a degree of thoroughness, shows 2,774 women engaged in finishing, for whom satisfactory data could be secured. The chief interest in these figures lies, not in the wage scale which they reveal—there is nothing unusual in that—but in the fact that Mr. Manly, in making the study, procured for this group of women the

[40] Report on Paper and News-print Paper Industry, 62d Congress, 1st Session, Senate Document 31, Washington, Government Printing Office, 1911, p. 111.

[41] "Wages and Hours of Labor in the Cigar and Clothing Industries, 1911 and 1912," United States Department of Labor, Bulletin 135, Washington, Government Printing Office, 1913, pp. 25–80.

[42] *Ibid.*, pp. 5–25.

actual earnings, as well as the wage rates. Thus far, in the course of this study, wage *rates* have been considered almost exclusively, and the yearly rate has been derived by multiplying the weekly wage rate by fifty-two, and the monthly wage rate by twelve. Under these circumstance, no allowance is made for loss of time due to sickness, shortage of orders, and other causes of unemployment. The following table for the glass industry makes the contrast in excellent form:

TABLE IV

EARNINGS OF WOMEN IN THE FINISHING DEPARTMENT OF THE GLASS INDUSTRY[43]

	Total Employed	Earnings per Year of Less Than		
		$250	$500	$500 and Over
Full time	2,774	38.9	97.4	2.6
Actual earnings	2,774	56.5	98.1	1.9

The wage scale shown by this table for the glass industry would lead one to conclude that two fifths of the women were receiving less than $250 per year. As a matter of fact, the proportion of women whose earnings were less than $250 per year was nearly three fifths. Deductions in one form or another nearly always drag a wage scale considerably below its face value.

The wages actually paid in the Chicago slaughtering and meat-packing industry are given in a most satisfactory way by J. C. Kennedy in a recent study. Mr. Kennedy obtained access to the pay rolls, and was thus able to discover the wages actually paid during a long period. The figures are peculiarly interesting, relating, as they do, to one of the chief centers in which one of the great industries in the country is carried on. It is, indeed, difficult to overemphasize their importance as portraying the present income situation in a leading industry.

TABLE V

WEEKLY WAGES ACTUALLY PAID IN CERTAIN PACKING PLANTS OF CHICAGO[44]

	Total Employed	Per Cent. Receiving Wages per Year of Less Than			
		$250	$500	$750	$1,000
Males	7,096	12	39	83	96
Females	1,064	27	92	99	..

A quarter of the women and a tenth of the men are paid less than a $250 rate; two fifths of the men and nine tenths of the women fall under $500. These figures would be further modified if they made allowances for unemployment throughout the year. As they stand they are the result of a simple process of multiplication.

43 "Woman and Child Wage-earners in the United States," Charles P. Neill, Washington, Government Printing Office, 1911, Volume III., p. 405.

44 "Wages and Family Budgets in the Chicago Stock Yards District," J. C. Kennedy, Chicago, University of Chicago Press, 1914, p. 12.

The wage rates for the manufacturing industries are, for convenience, summarized in Tables VI. and VII. Practically all of the figures show wage rates rather than earnings.

TABLE VI

COMPENSATION WAGES FOR MALE WAGE-EARNERS IN CERTAIN MANUFACTURING INDUSTRIES

	Total Employed	Per Cent. of Males Receiving Wage Rates Per Year of Less Than					
		$250	$500	$750	$1,000	$1,250	$1,500
Iron and steel industry (1910)........	172,706	....	8	60	85	......	97
Textiles—cotton (1910–11),							
North..........................	11,041	5	54	94	......	......	......
South..........................	3,784	22	85	97	......	......	......
Woolen and worsted (1910–11),							
Dyeing.........................	791	....	87	92	......	......	......
Finishing......................	1,644	2	76	85	......	......	......
Lawrence (1911)..................	11,075	5	56	....	......	......	......
Little Falls (1912)................	2,502	7	63	87	96	......	......
Woolen (Bureau of Labor 1910–11)...	17,178	1	30	77	97	......	......
Cotton (Bureau of Labor 1910–11) ...	28,478	8	57	97	......	......	......
Pulp and paper industry (1910)......	9,173	....	32	83	94	96	96
Lumber (1910–11)..................	59,228	....	39	91	96	......	99
Mill work (1910–11)................	32,405	....	14	57	74	......	98
Furniture (1910–11)................	34,095	....	10	47	93	......	99
Cigar (1910–11)....................	3,615	....	6	29	53	......	96
Meat packing (1910–11)............	7,096	12	39	83	96	......	......

TABLE VII

COMPENSATION RATES FOR FEMALE WAGE-EARNERS IN CERTAIN MANUFACTURING INDUSTRIES

	Total Employed	Per Cent. of Females Receiving Wage Rates Per Year of Less Than			
		$250	$500	$750	$1,000
Textiles—cotton (1910–11)					
North..............................	12,424	9	81	......	......
South..............................	2,337	47	97	......	......
Woolen and worsted (1910–11), Finishing.....	2,886	13	86	97	......
Lawrence (1911)........................	8,320	8	86	......	......
Little Falls (1912)........................	2,736	13	78	99.8	......
Woolen (Bureau of Labor 1910–11)..........	18,144	5	53	97	......
Cotton (Bureau of Labor 1910–11)..........	38,445	19	83	99	......
Cigar (1910–11)..........................	7,551	11	44	86	96
Glass finishing (1909)....................	2,774	39	97	......	......
Meat packing (1910)....................	1,064	27	92	99	......

There is every difficulty in the way of generalizing from these scattered instances. On the face of the returns, the wages for men are much higher than the wages for women. Both appear distributed over the wage scale in varying proportions, depending upon the industry. With the exception of the finishing departments of the woolen mills, the wages paid in the textile industry appear to be lower than those paid in any other of these industries; the wage rates fall in the vast majority

of instances for the men, under $1,000, and for the women, under $750. In most industries, from a third to a half of the men receive less than $500; and usually at least three quarters receive less than $750. Four fifths of the women are paid less than $500. Women working in the manufacturing industries receive, for the most part, wages varying from $250 to $500.

VIII. Wage Rates Paid in the Manufacturing Industries, as Reported by Certain States and by the United States Census

Much emphasis has been placed upon the wage figures derived in the course of special wage investigations, because in most cases these figures represent actual conditions at a definite time. There remain the general figures for manufacturing industries published by certain states and by the United States Census Bureau. In neither case do these figures materially alter the conclusions which were derived as a result of the study of special wage investigations.

The wage facts secured by many states are grossly inadequate.[45] Nevertheless, there is a growing body of usable information relative to the wage scales paid in certain states. As regards the excellency of their figures, New Jersey and Massachusetts are well in the lead. Several other states are making strenuous efforts to duplicate or better their good work.

The state wage figures are usually given in two forms. First, in the form of wages for the entire state; and second, in the form of wages for certain industries. Several states present, in addition, wages for the larger cities. The figures for the entire state are meaningless in one sense, because of the great diversity of industries. In another sense, they are profoundly significant. The wage statistics, for example, of Massachusetts show for six hundred thousand men and women (out of a total population of 3,366,416 in 1910) what the wage scale is in the manufacturing industries. There could be no more effective metrical test applied to the community, unless the actual family incomes were measured. The wage scale for the manufacturing industries of a manufacturing state shows at least roughly the economic background of the people living in the State. For both New Jersey and Massachusetts, two of the six leading manufacturing states, there are extant sufficient wage figures to paint the economic background of the great body of the industrial population in these states.

An examination of the figures for various states, and for all of the leading industries of the country, corroborates the conclusions already made from the special reports. The wage rates are such that, making no allowance for unemployment, about one tenth of the males receive more than $1,000 per year, and about one eighth of the females more than $500 per year. At the same time, from a quarter to a third of

[45] "Wages in the United States," *op. cit.*, Chapters 1 and 2.

the males receive less than $500 per year, and from a tenth to a fifth of the females receive less than $250 per year. Thus the great bulk of the males are paid wage rates varying from $500 to $1,000, while the great bulk of the females are paid wage rates of from $250 to $500. To this general statement, Oklahoma and California are exceptions. The wage rates there are considerably higher than in the east.

The figures for the manufacturing industries, in the states compiling such figures, include practically all of the persons occupied in the manufacturing industries within a given state. The Census figures include only a fraction of the employees engaged in the manufacturing industry. The Census figures are interesting chiefly because they include a wide geographical range. They virtually cover an industry for the entire country. They differ in no essential particular from the conclusions already derived from the state and special wage figures.

IX. The Income of Wage-Earners Engaged in Public Utilities

Recent studies have made available a few figures which show the scale of wages paid by public utilities. These wages are higher than the wages for industry in general, but they are not materially higher than the wages paid in the other man-employing industries.

Three states (New York, Oklahoma and Kansas) publish wage rates for public utilities. The New York figures are for the First District. There were in 1911 38,139 employees on the street railways of the First District. Of this number the wages of 9,635 men employed by "selected" companies are tabulated. Of the total, 5 per cent. received less than $500 per year; two fifths received less than $750; and nine tenths received less than $1,000.[46] The gas and electric companies in the same district report the employment of 16,741 men, for whom the range of wages is considerably higher than the range for street railway employees. Eight per cent. were receiving wage rates under $500, 45 per cent. under $750, three quarters under $1,000, and nine tenths under $1,250.[47]

The figures for the two Western States differ little from those for New York. The Oklahoma report, covering 1,129 adult males engaged in public utilities, gives the wage rates for two thirds as under $750, and nine tenths as under $1,000.[48] In Kansas, of the 702 adult males reported as employed, three quarters received less than $750, and 95 per cent. less than $1,000.[49]

The compensation rates of persons employed in public utilities are fairly uniform. These occupations apparently range among the better-

[46] Annual Report of the Public Service Commission of New York, *op. cit.*, pp. 334–339.

[47] *Ibid.*, Volume III., pp. 280.

[48] Annual Report of the Department of Labor, Oklahoma, 1911–12, p. 209.

[49] Annual Report, Kansas Bureau of Labor, 1909, Topeka, 1910, p. 21.

paid occupations of the country. The following summary shows the available figures:

TABLE VIII

COMPENSATION RATE FOR MALE WAGE-EARNERS IN PUBLIC UTILITIES

	Total Employed	Per Cent. of Males Receiving Wage Rates per Year of Less Than			
		$500	$750	$1,000	$1,250
New York (First District),					
Street Railway	9,635	6	42	89	......
Gas and Electric	16,741	8	45	76	88
Oklahoma	1,129	7	65	89	......
Kansas	702	24	74	95	......

X. THE WAGE RATES FOR MINES AND QUARRIES

The volume of the Thirteenth Census devoted to mines and quarries omitted any statement of classified wages. The only general data on the subject appear in the special Census report on mines and quarries issued in 1902.[50] The data contained in this volume are now so thoroughly out of date that only a brief reference to them will be made.

There were in 1902 581,728 wage-earners engaged in the production of all forms of minerals. The wage rates per day of these men are given by industries, by occupations, and by geographical divisions.

The tables showing the classified earnings of all wage-earners in the mining industry report 16 per cent. of the men as receiving less than $1.74 per day ($500 a year); 62 per cent. received less than $2.49 per day ($750 per year); and 93 per cent. received less than $3.49 per day ($1,050 per year). This showing, on its face, makes the wage scale in the mining industry correspond rather closely with that in the manufacturing and mercantile industries.

One further fact of the greatest significance must be borne in mind,—the ratio of unemployment in the mining industry, particularly in the coal-mining industry, is comparatively high.[51] The federal report on the production of coal in 1910[52] shows an average number of days worked in the bituminous coal mines of 217 out of a possible 306, and in the anthracite coal mines of 229 out of a possible 306 days. Under the circumstances it is not fair to make a direct comparison between the wage rates in manufacturing and in mining, derived by multiplying the day rate by 306. The proportion of unemployment, particularly in the coal mining industries, is very much higher.

Almost one half of the total number of persons employed in mining in 1902 were in the bituminous coal mines. Of the bituminous coal

[50] Washington, Government Printing Office, 1905, pp. 90–101.

[51] "Unemployment in the United States," Scott Nearing, Quarterly Publications of American Statistical Association, Volume II., September, 1909, p. 534.

[52] "Mineral Resources of the United States," Washington, Government Printing Office, 1911, p. 41.

miners, 280,638, only 9 per cent., were paid less than $1.75 per day; 20 per cent. were paid less than $2.00 per day; 58 per cent. were paid less than $2.50 per day; and 95 per cent. were paid less than $3.50 per day. The rates of pay for anthracite coal mining (employing 69,691 men) were very much lower than the rates for bituminous coal mining. Thirty-one per cent. of the anthracite coal miners received less than $1.75 per day; 46 per cent. received less than $2.00 per day; 74 per cent. received less than $2.50 per day; and 95 per cent. received less than $3.50 per day.

The production of iron ore involved the employment of 38,851 men. These were paid less than $1.75 in 22 per cent. of the cases, less than $2.00 in 37 per cent. of the cases, less than $2.50 in 78 per cent. of the cases, and less than $3.50 in 99 per cent. of the cases.

Among the 36,142 wage-earners engaged in gold and silver mining, 2 per cent. were paid less than $1.75; 8 per cent. were paid less than $2.50; and 67 per cent. were paid less than $3.50. There is thus a marked variation in the wage rates paid for mining in the different mining industries. The fairest comparison, if a comparison between wages in manufacturing and wages in mining industries is to be made, must recognize the geographical wage variations. Most of the wages from manufacturing industries relate to the North Atlantic and the North Central States. An examination of the figures for mining shows that the wage rates paid in these states are considerably lower than the wage rates in the Western States, where smelting and refining are the chief mining industries. Two fifths of the wage-earners employed in mines and quarries in the United States were in the North Atlantic States; a third were in the North Central States; and only an eighth were in the Western States. The great bulk of the mining work is therefore carried on in the North Central States.

The wages in the North Atlantic Division relate to coal mining, chiefly. They are somewhat lower than the wages reported for the North Central States, as appears in the following comparison:

Table IX

Wage Rate Per Day Less Than	North Atlantic Division	North Central Division
$1.75	20 per Cent.	6 Per Cent.
$2.00	36 Per Cent.	19 Per Cent.
$2.50	69 Per Cent.	63 Per Cent.
$3.50	95 Per Cent.	96 Per Cent.

Although these figures for mines and quarries are so far out of date that no well-marked conclusions may be based on them, they indicate that in the mining industry wage rates are comparatively similar to the rates in the manufacturing industries in like geographical sections.

XI. Service Incomes in Organized Industry

The figures cited in this chapter are far from conclusive. They are, in many cases, woefully incomplete. They cover only a part of the industries in which men and women are gainfully employed. The most surprising thing about the figures is their uniformity. Collected by different organizations, and under essentially varied conditions, the product of general state and federal inquiry and of specific individual wage investigations, the figures agree marvelously. Wages in the west are generally higher than wages in the east.[53] Throughout the country lying east of the Rocky Mountains, and in the industrial sections lying north of the Mason and Dixon Line, the facts appear to be unquestionable and unquestioned. Subsequent investigation will reveal minor variations, but the large wage facts will still stand as they do in these summaries.

A comparatively small percentage of the persons gainfully employed in modern organized industry are on a salary basis. Of those so classified, the great proportion are foremen, assistant superintendents and managers, and clerks, whose salaries, for the most part, differ little from the salaries of the better-paid wage-earners. A small proportion of them are paid more than $1,000 per year, and a vanishing number receive more than $1,500. The vast majority of those gainfully employed in organized industry, certainly 95 per cent., are paid a wage or its equivalent. The figures showing that wage appear in the following brief summary:

Table X

Compensation Rates for Males in Certain Groups of Occupations

	Per Cent. of Males Receiving Wage Rates per Year of Less Than					
	$250	$500	$750	$1,000	$1,250	$1,500
Bell Telephone System Leading Occupations (1908)	......	5	40	80	......	99
Mercantile establishments, California (1911–12)	......	10	30	55	......	......
Iron and steel, United States (1910)	......	10	60	85	......	97
Textiles (1910–12)	......	60	90	95	......	......
Miscellaneous (1910–11)	......	30	60	90	......	98
Manufacturing:						
Massachusetts (1910)	1	34	71	91	......	......
New Jersey (1911)	2	36	71	89	......	......
Kansas (1909)	2	26	70	91	......	......
Wisconsin (1909)	2	32	77	94	......	99
Oklahoma (1911)	1	17	68	90	......	......
California (1911)	2	7	30	63	......	......
Census (1905)	8	47	79	94	......	......

The conclusions from these figures are inevitable. The great majority (almost nine tenths) of the adult males receive wage rates of $1,000 per year, or less. An equal proportion of females receive less than $750.

[53] "Wages in the United States," *op. cit.*, Chapter 8.

TABLE XI

COMPENSATION RATES FOR FEMALES IN CERTAIN GROUPS OF OCCUPATIONS

	Per Cent. of Females Receiving Wage Rates Per Year of Less Than			
	$250	$500	$750	$1,000
Mercantile establishments:				
California cities (1911–12):				
Retail	10	35	75	95
Wholesale	3	20	60	90
Baltimore stores, Saleswomen (1909)	54	95	99	....
Washington stores, Saleswomen (1912)	25	87	....	....
Textile manufacturing (1911–12)	15	85	98	....
Miscellaneous (1909–11)	25	90	98	....
Manufacturing:				
Massachusetts (1910)	7	79	99	....
New Jersey (1911)	17	86	98	99
Kansas (1909)	25	88	98	100
Wisconsin (1909)	32	93	98	99
Oklahoma (1911)	8	84	97	99
California (1911)	9	40	82	97
Census (1905)	34	92	99	....

The wage rates of four fifths of the males fall below $750; a third below $500. Among female wage-earners the scale is much lower. Three quarters or four fifths are paid less than $500 per year. These statements make no allowance for unemployment, which is a constant irreducible factor. Unemployment due to lack of work alone is generally met with.[54] Add to this the unemployment produced by sickness, accidents and other personal causes, and the proportion is still higher.

These facts make one thing impossible. Hereafter no one need discourse at length on the theme of the spendthrift laborer and the ensuing hardship of his family. The wage scale of the country is so adjusted at the present time that the vast majority of the recipients of wages and salaries are paid a wage which, when compared with the cost of a decent or fair standard of living, appears in many instances insufficient, and in many others, barely adequate, to procure the decencies of life. The time may come when the laborer's condition is due to his extravagance and lack of foresight. For the present, the scale of service income offers an explanation so telling that it would require hardihood of unusual type to saddle even a major portion of the blame for the situation on the individual worker.

[54] An idea of the extent of unemployment may be gained from the reports of the New Jersey and the Massachusetts Labor Bureaus, showing the number of days worked in the various industries. See Bureau of Statistics of New Jersey, 1913, Paterson, 1914, pp. 125–128. Also Statistics of Manufactures for 1911, Bureau of Statistics for Massachusetts, Public Document 36, Boston, 1913, p. 137.

FAMILIES OF AMERICAN MEN OF SCIENCE

By J. McKEEN CATTELL

IN a series of articles entitled "A Statistical Study of American Men of Science," printed in *Science* in 1906 and 1910 and as an appendix to "The Biographical Directory of American Men of Science," methods were explained by which the thousand leading scientific men of the United States had been selected and arranged in the order of the merit of their work. Studies were made of the measurement of scientific performance, of the origin and distribution of scientific men, and of the changes which occurred during an interval of several years. Data have now been gathered in regard to the families of the men of science previously selected. In our present state of ignorance a statistical study of any homogeneous and objectively chosen group should be of value, both as a contribution to psychological and vital statistics in general and for comparison with other groups which may be similarly studied. Scientific men form a desirable group for such study as, on the one hand, they may be assumed to be willing and competent to supply the information and, on the other hand, knowledge concerning the conditions favorable to scientific performance may have important practical applications.

Of one thousand one hundred and fifty-four scientific men from whom information in regard to their families was requested 1,036 replied and 118 did not. Of the replies 16 were blank, sometimes accompanied by the explanation that the information was not readily attainable or the like, 7 were to the effect that the information would be sent later or the like, 13 were received too late, 25 were very imperfect, 975 were usable and in most cases complete. This is an unusually full reply to a questionnaire. For example, in answer to an inquiry in regard to noteworthy relatives addressed to 467 fellows of the Royal Society, Sir Francis Galton received 207 useful replies, and the completely available returns "scarcely exceeded 100." In such cases it is desirable that returns should be complete in order to avoid the selection of a special class. Thus, when people are asked whether they have noteworthy relatives, those having them are more likely to reply than others, and the percentage of positive replies may give no definite information in regard to the frequency. In the present case it appears, from examination of the names of the ten per cent. who failed to reply, that there was no group that would affect appreciably the result of the inquiry.

I. Origin, Heredity and Performance

In the previous articles statistics were given in regard to the birthplace of the scientific men, and data are now at hand in regard to the nationality and race of their parents. Of the thousand scientific men first selected 126 were born abroad—34 in Canada, 38 in Great Britain and 19 in Germany. Table I. gives the nationality of the parents of 917 leading scientific men. Six hundred and twenty-eight, or more than two thirds, have both parents of native American (United States) birth, 23 others have an American father and 42 an American mother, foreign men having American women more frequently than the reverse. In 165 cases both parents are foreign born and of the same nationality. Including Americans there are 124 marriages in which the nationality of the parents was mixed, but they were largely British. The American-born parents are mainly of British and New England descent; of foreign-born parents, 137 fathers and an equal number of mothers are English, Scotch, Irish or Canadian. Germany contributes 77 fathers and 66 mothers. Other nations contribute in all 51 fathers and 44 mothers—fairly equally distributed among Norwegians, Swedes, Russians, Dutch, French and Swiss, with several from Denmark, Italy and Japan. The parents of American men of science are thus predominantly British-American, with an admixture of nearly 8 per cent. of Germans and about 5 per cent. from other nationalities.

Table I. Nationality of the Parents of American Men of Science

	Both Parents	Father Only	Mother Only	Total Families
American..	628	23	42	660.5
English...	48	36	28	80
Scotch....	9	13	15	23
Irish......	4	10	12	15
Canadian..	14	3	7	19
German...	54	23	12	71.5
Norwegian.	6	0	0	6
Swedish...	6	0	0	6
Danish....	1	2	1	2.5
Russian...	6	0	0	6
Dutch.....	3	3	5	7
French....	6	6	2	10
Swiss.....	6	4	0	8
Italian....	0	1	0	0.5
Japanese..	2	0	0	2
Total...	793	124	124	917

Twelve and six tenths per cent. of our leading scientific men are foreign born, 12.6 per cent. are native born of foreign-born parents, and 7.1 per cent. have one foreign-born parent. In the general population of the United States 14 per cent. of the people are foreign born, 13.5 have both parents foreign born and 6.7 have one parent foreign-born. The foreign born and those of foreign-born parentage thus contribute less, but only slightly less, than the native population to scientific productivity. There is a great difference in the different nationalities. Those born in Great Britain contribute 1.2 per cent to the population and 3.4 per cent. to our scientific men; Germany contributes 2.7 per cent. to the population and 1.9 per cent. to the scientific men; Russia 1.7 to the population and 0.6 to the scientific men; Italy 1.5 to

the population and 0.1 to the scientific men. These differences are not, however, necessarily due to any racial superiority of the British and Germans. Men have been called from these countries to scientific positions here or have come to seek them, and in general a larger proportion of their immigrants have been from the educated classes. In my own science men so distinguished as Professor Münsterberg from Germany and Professor Titchener from England have accepted chairs of psychology in our universities. It is most unfortunate for us that this movement appears to have ceased. Between 1903 and 1910 only one scientific man of high distinction was called to this country, whereas nine leading scientific men returned to their native countries.

We could and should see to it that the foreigners coming to the United States contribute their share of men of performance. From the point of view of national selfishness nothing could be more profitable than to add to the community as many foreign men of distinction as would come for five or ten thousand dollars a year, and as many young men of promise as would come for one or two thousand dollars a year. Such men are already selected and their education is paid for. We have paid for the education of some 150,000 physicians to obtain at most 1,000 who are competent to advance medical science. The services of this thousand are probably worth as much as those of all the others combined, so if we divide equally the cost of bringing up and educating these physicians, the cost of a man competent to advance science is perhaps $500,000 and his value is far greater. Such men we can obtain from abroad free of cost beyond the payment for their living, which must be paid equally to those who are educated and selected at our own expense. Not only the men themselves, but their descendants also are assets to the country of incalculable value. From the point of view of the world at large, it is probably an advantage to bring men of distinction and of promise to this country, as this tends to promote friendly international relations and good-will, and because, the wealth being greater here and the competition less, we should be able to give better opportunity to the men. The war has placed on us great responsibility; we should provide for those debarred from advancing science, scholarship and art at home. If Great Britain can afford to cast ten billion dollars into the abyss, we are able to invest an equal sum to advance the arts of civilization.

While it is comparatively easy to determine the nationality of scientific men and of their parents, it is almost impossible to determine their race. Indeed, a consideration of the subject leads to a realization of the complexity of the racial descent of the peoples forming the nations of western Europe and America. There are 13.5 families stated to be Jews. Of 71.5 German families, 8 are Jews; of 6 Russian families, 5 are Jews; among 660.5 native American families, there is only one Jewish parent. There may be some unrecorded cases; the

number of native-born scientific men of Jewish family is smaller than might have been anticipated. Two families are Japanese; none is known to be of Negro or of North American Indian descent.

The scientific men have been divided into four groups in accordance with the merit of their performance. These are: I. those among the leading hundred of our scientific men; II. those among the second and and third hundreds; III. those below this rank in the thousand; and IV. those who in the second arrangement fell below the thousand. As shown in the previous paper, the first three groups cover about equal ranges of merit, and this also holds in a general way for the fourth group. In Table II. is given the nationality of the parents of the scientific men in accordance with these grades. Those of American parentage are of average standing; those of British parentage are below and those of German parentage are above the average. Those of other nationalities are slightly above the average. Among the leading hundred men of science seven are of Jewish family. The Jewish race thus appears to show superior intellectual ability. The differences in the other nationalities and races are so small as to indicate practical equality. The slight superiority of the Germans is due to several men who have come to this country to fill scientific positions, half of whom are of Jewish descent.

TABLE II. THE PERCENTAGE OF THE SCIENTIFIC MEN IN EACH OF FOUR GRADES ACCORDING TO THE NATIONALITY OF THEIR PARENTS

	No.	Percentage of Each Grade			
		I	II	III	IV
American.	652.5	7.7	18.3	57.9	16.0
British...	137	6.6	17.9	56.9	18.7
German..	73.5	10.2	20.4	57.1	12,2
Others....	48	8.3	20.8	56.3	14.6
Total....	911	71	169	525	146
Per cent.		7.8	18.6	57.6	16.0

TABLE III. THE OCCUPATIONS OF THE FATHERS OF THE SCIENTIFIC MEN

	No.	Per Cent.	Percentage of Each Grade.			
			I	II	III	IV
Professions.....	381	43.0	8.9	18.4	57.5	15.2
Clergymen....	89	10.1	5.6	19.1	60.7	14.6
Physicians....	66	7.5	9.1	18.2	50.9	22.7
Lawyers......	58	6.6	10.3	24.2	51.7	13.8
Teachers......	74	8.3	10.8	18.9	59.5	10.8
Others........	94	10.6	9.6	13.8	61.7	14.9
Agriculture.....	188	21.2	3.7	20.7	56.4	19.2
Manuf. and trade	316	35.7	7.9	17.4	61.1	13.6
Total........	885		7.5	18.5	58.5	15.5

The occupations of the fathers of 885 scientific men are given in Table III. Forty-three per cent. belong to the professional classes; 21.2 per cent. to the agricultural classes and 35.7 per cent. to the

manufacturing and business classes. In the United States in 1850, 3.1 per cent. of white men having occupations were in the professions; 44.1 were engaged in agriculture, and 34.1 in trade, transportation, manufacturing and mechanical pursuits. The professional classes have thus contributed in proportion to their numbers about fourteen times as many scientific men as the others, the agricultural classes only half as many as the manufacturing and trading classes. The farm not only produces relatively fewer scientific men, but a smaller proportion of them are of high distinction and a larger proportion are in the lowest group. This traverses a common belief, as voiced, for example, by Dr. Charles W. Eliot, when he writes:

> The country breeding gives a vigor and an endurance which in the long run outweigh all city advantages, and enable the well-endowed country boys to outstrip their city-bred competitors.[1]

The writer showed, however, in the previous paper that in proportion to their population cities have produced twice as many scientific men as the country.

The four professions of divinity, medicine, law and teaching, with a fifth group composed of the remaining professions—engineering, fine arts, journalism, the government service, etc.—contribute numbers of scientific men not far from equal. According to the census of 1850, the numbers in the four learned professions were: Clergymen, 26,842; lawyers, 23,939; physicians, 40,765; men teachers, 30,530. For each thousand of their members, they contributed scientific men as follows:

Clergymen	3.3
Lawyers	2.5
Teachers	2.4
Physicians	1.6

Clergymen, therefore, have the best record, and physicians the worst. Yet at that period there was supposed to be a conflict between science and theology, and the work of the physician is, or should be, allied to, if not identical with, that of the man of science. But in the middle of the last century the clergymen were likely to be better educated and more closely identified with the colleges than the physicians. The lawyers and the teachers were equally productive, but college professors —of whom there were only 943 in 1850—are far before any other class. The group of "other professions" is too ill defined to permit statistical treatment. In the census of 1850, mechanics who ran engines were called engineers and included among the professions. It will be noted from the table that lawyers and teachers have contributed the largest

[1] "Family Stocks in a Democracy," American Contributions to Civilization, 1898.

percentage of scientific men of high distinction, but the differences are not so large as to be significant.

As it is much easier to determine nationality than race, so occupation can be stated more readily than social position. It would be desirable to know the social connections and incomes of the fathers of scientific men at the period when their sons were educated, but such information is not at hand. Men in the same profession have very different social environments; in manufacturing and trade a man may be an artisan or a multi-millionaire. It is, however, clear that a majority of scientific men come from the so-called middle and upper classes. Not very far from half of them are supplied by the professional classes, forming about one thirtieth of the population, and undoubtedly they tend to be sons of the more successful professional men. Under manufacturing and trade all sorts of occupations are included, but only a small part of the fathers belong to the class of artisans and still fewer to the class of clerks. Most of them own their own business, which may be anything from a small shop in a university town[2] to the control of a railway system. Not a single scientific man is recorded as coming from the class engaged in domestic service, nor is any known to be the son of a day laborer, even of the higher grades. Agriculture includes agricultural laborers, but the fathers of the scientific men usually owned their own farms, and were probably in the main the farmers of the better class with relatives among professional men. Our farming population belongs chiefly to a yeoman class, not to a peasant class, such as forms nine tenths of the population of Russia.

The earlier studies of scientific men made by De Candolle and Galton and the groups treated by Odin and Ellis yield results in regard to the origin of men of performance comparable with those here given. De Candolle[3] found that of 100 foreign associates of the Paris Academy of Sciences, 41 came from noble and wealthy families, 52 from the middle class and 7 from the working class. Galton[4] found that of 96 contemporary leading men of science none came from the artisan and peasant classes. Odin[5] found that of 823 French men of letters, 65 per cent. came from the nobility and governing classes, 23 per cent. from the professions, 12 per cent. from the commercial and middle classes and 16 per cent. from the lower classes. Ellis[6] found that of 829

[2] A notable case is of three brothers who have attained scientific distinction. They obviously had inherited ability, but the opportunity to exhibit it in scientific research was probably due to the fact that their father's shop was in a university town.

[3] "Histoire des Sciences et des Savants depuis deux Siècles," Genève, 1873.

[4] "English Men of Science," London, 1874; New York, 1875.

[5] "Genèse des Grands Hommes," Paris et Lausanne, 1895. An excellent account of Odin's researches is given in Lester F. Ward's "Applied Sociology," Boston and New York, 1906.

[6] "A Study of British Genius," London, 1904.

British men of genius 18.5 per cent. came from the nobility and upper classes, 41.3 per cent. from the professions, 31.2 from the manufacturing and commercial classes, 6 per cent. from the yeomen and farmers and 2.5 from the artisan and laboring classes.

The working classes outnumber the nobility a hundredfold, but produce only one quarter as many men of performance. If the working classes have equal ability and if they had been given equal opportunity, instead of a hundred scientific men of the rank of the foreign associates of the Paris Academy there would have been forty thousand. It may be that the peasant and artisan classes in European countries are separated from the upper classes by an inferior heredity; but that is scarcely the case in America. Five or ten generations back most of us have ancestors of nearly the same average physical, intellectual and social condition; any selection for ability within this short period must be slight and transient.

It is evident that what a man can do depends on his congenital equipment. How far what he does do depends on his environment and how far on his congenital equipment, or how far his congenital equipment depends on that of his parents and his family line of descent, we do not know. Most sociological writers and some biologists are confused in their use of the concept of heredity. When there is discussion of the relative influence on performance of heredity and environment, by heredity there is sometimes understood the original constitution of the individual and sometimes his resemblance to parents and other relatives. It is conceivable that the original constitution of son and father might be exactly the same and yet the individual be so plastic to environment that under different conditions there would be but slight similarity between their performances. It is also conceivable that there might be no similarity between the original constitution of son and father, and yet the performance of each be determined by his original constitution almost without influence from environment. Under which of these extreme hypotheses would the current sociologist call heredity strong or weak? The word heredity should be reserved for resemblance due to a common germ plasm and some other word found for the constitution of the fertilized ovum or zygote; perhaps the best that can be done is to use this uncouth word. We can then discriminate between the two distinct questions: What is the resemblance between the zygotes of two brothers? How far does the zygote of an individual determine his performance as an adult?

The distinctions are of vast importance for the organization of society. If men of performance could only come from superior family lines, this would be a conclusive argument for a privileged class and for a hereditary aristocracy. If the congenital equipment of an individual should prescribe completely what he will accomplish in life, equality

of opportunity, education and social reform would be of no significance. Such an extreme position, though it is approached by men with so much authority as Sir Francis Galton, Professor Karl Pearson, Dr. F. A. Woods, Dr. C. B. Davenport and Professor E. L. Thorndike, is untenable. Equally extreme in the opposite direction is M. Odin's aphorism "Genius is in things not in men," or the not uncommon opinion that almost anything can be done with a child by training and education. It is a problem of degree and of circumstance, a scientific question that could probably be solved within a reasonable time, if as much intelligence and money were devoted to it as to one of the bureaus of the Department of Agriculture.

In the meanwhile we must do the best we can with the material at hand, even though the interpretation is in nearly all cases ambiguous. It is here shown that 43 per cent. of our leading scientific men have come from the professional classes. We may conclude that more than one half of our men of science come from the one per cent. of the population most favorably situated to produce them. The son of a successful professional man is fifty times as likely to become a leading scientific man as a boy taken at random from the community. My data also show that a boy born in Massachusetts or Connecticut has been fifty times as likely to become a scientific man as a boy born along the southeastern seaboard from Georgia to Louisiana. They further show that a boy is fifty times as likely to do scientific work as a girl. No negro in this country has hitherto accomplished scientific work of consequence. A boy from the professional classes in New England has a million chances to become a scientific leader as compared with one chance for a negro girl from the cotton-fields.

These great differences may properly be attributed in part to natural capacity and in part to opportunity. When it is asked how far the result is due to each of these factors, the question is in a sense ambiguous. It is like asking whether the extension of a spiral spring is due to the spring or to the force applied. Some springs can not be extended a foot by any force; no spring can be extended without force. The result depends on the relation between the constitution of the spring and the force applied. If the 174 babies born in Massachusetts and Connecticut who became leading scientific men had been exchanged with babies born in the south, it seems probable that few or none of them would have become scientific men. It may also be the case that few or none of the babies from the south transplanted to New England would have become scientific men, but it is probably true that a nearly equal number of scientific men would have been reared in New England. It is certain that there would not have been 174 leading scientific men from the extreme southern states and practically none from Massachusetts and Connecticut. If the stock of the southern states remains undiluted, it may, as social conditions change, produce even

more scientific men per thousand of its population than New England has hitherto produced. In the first list of the thousand leading scientific men, Massachusetts produced 109 and Connecticut 87 per million of their population. Of the younger men added to the list in the second arrangement under comparable conditions, Massachusetts produced 85 and Connecticut 57. The other North Atlantic states failed in like measure, while the central states show a gain—Michigan from 36 to 74, Minnesota from 23 to 59, etc. These changes must be attributed to an altered environment, not to an altered racial stock. Japan had no scientific men a generation ago and China has none now, but it may be that in a few years their contributions to science will rival ours.

A Darwin born in China in 1809 could not have become a Darwin, nor could a Lincoln born here on the same day have become a Lincoln had there been no civil war. If the two infants had been exchanged there would have been no Darwin in America and no Lincoln in England. Darwin was a member of a distinguished family line possessing high natural ability and the advantages of opportunity and wealth. Lincoln had no parental inheritance of ability or wealth, but he too had innate capacity and the opportunity of circumstance. If no infants had been born with the peculiar natural constitutions of Darwin and Lincoln, men like them could not have been made by any social institutions, but none the less the work they did might have been accomplished by others and perhaps their fame would have been allotted to others. There may have been in England other family lines equal in natural ability to the Darwins and in this country other individuals as well constituted as Lincoln, but undistinguished from lack of opportunity. It is still more probable that such conditions obtain in Russia and in China, in whose graveyards there may lie innumerable "mute inglorious" Miltons, Lincolns and Darwins.

The most exceptional ability may be suppressed by circumstances; but it can sometimes deal with them on equal or perhaps superior terms. Thus the writer has pointed out how widely distributed in race, age and performance are the most distinguished men who have lived.[7] When we turn from the most eminent men to those next in rank, we may doubt whether their natural ability has not been equaled by thousands who have not attained distinction. Among the two hundred most eminent men who have lived in the history of the world are: Napoleon III., Nero, Fox, Julian, Fénelon, Clive, Alberoni, Bentley and Gerson. It is quite conceivable that there are at present living in the United States hundreds or thousands of men having as great natural ability as these. There may be a hundred thousand men and women

[7] "A Statistical Study of Eminent Men," THE POPULAR SCIENCE MONTHLY, 1903.

having the natural and specific ability of the thousand in this country who have accomplished the best scientific work.

President A. Lawrence Lowell has remarked that we have a better chance of rearing eaglets from eagles' eggs placed under a hen than from hen's eggs placed in an eagle's nest. But it is equally true that we have a better chance of raising tame eaglets in a chicken coop than in an eyrie. The difference between a man uninterested in science and a scientific man is not that between a chicken and an eagle, but that between an untrained chicken and a trick cock. Some cockerels can be trained better than others, but there are innumerable cockerels that might be trained and are not.

The son of a scientific man may on the average have the inherited ability which would make him under equally favorable circumstances twice, or ten times, or a hundred times, as likely to do good scientific work as a boy taken at random from the community. The degree of advantage should be determined. It surely exists, and the children of scientific men should be numerous and well cared for. But we can do even more to increase the number of productive scientific men by proper selection from the whole community and by giving opportunity to those who are fit. Galton finds in the judges of England a notable proof of hereditary genius. It would be found to be much less in the judges of the United States. It could probably be shown by the same methods to be even stronger in the families conducting the leading publishing and banking houses of England and Germany. As I write, the death is announced of Sir William White, the distinguished naval engineer, chief constructor of the British navy, president of the British Association. If his father had been chief constructor of the navy, he would have been included among Galton's noteworthy families of fellows of the Royal Society. The fact that his father-in-law was chief constructor of the British navy throws, if only by way of illustration, a light on the situation in two directions.

On the one hand, the specific character of performance and degree of success are determined by family position and privilege as well as by physical heredity; on the other hand, marriage, chiefly determined by environment, is an important factor in maintaining family lines. The often-quoted cases of the Jukes and Edwards families are more largely due to environment and intermarriage within that environment than to the persistence of the traits of one individual through several generations. The recently published "Kallikak Family" by Dr. H. H. Goddard demonstrates once again the heredity of feeble-mindedness. It would, however, have been a stronger argument for the omnipotence of heredity if the original ancestor had left by a healthy mother illegitimate children who established prosperous lines of descent, and a child by a feeble-minded wife who left degenerate lines of descent. Two ex-

periments have been made on a large scale which seem fairly definite even though quantitative results can not at present be reached. The mulattoes may be assumed to have a heredity midway between negroes and whites, but their social environment is that of the negroes, and their performance corresponds with their social environment rather than with their heredity. Illegitimate children have perhaps a heredity as good as the average, but their performance falls far below the average. If performance were determined by heredity alone there might be expected to be among our thousand leading scientific men some forty mulattoes and some forty of illegitimate birth, whereas there is probably not one of either class.

At nearly the same time Agassiz came from abroad to Harvard and Brünnow to Michigan. We all know the list of distinguished naturalists trained under Agassiz—Brooks, Hyatt, Jordan, Lyman, Minot, Morse, Packard, Putnam, Scudder, Shaler, Verrill, Whitman, Wilder and many more, directly and indirectly. From Michigan have come, as is not so well known, one fourth of our most distinguished astronomers, including Abbe, Campbell, Comstock, Curtis, Doolittle, Hall, Hussey, Klotz, Leuschner, Payne, Schaeberle, Watson and Woodward. Certainly the coming of Agassiz and Brünnow was the real cause of greatly increased scientific productivity in America. Some, but not all, of those who worked under Agassiz would have become naturalists apart from his influence. The astronomers from Michigan must in the main be attributed to their environment. The men had the necessary ability, but if Brünnow had not gone to Michigan, they would not have become astronomers; if they had gone to the University of Pennsylvania, they would have been more likely to have become physicians than astronomers; if they had not gone to a university they would not have become scientific men.

It is certainly satisfactory if we can attribute the inferiority of scientific performance in America as compared with Germany, France and Great Britain to lack of opportunity rather than to lesser racial ability. In Germany scientific research has been made by the university rather than the reverse. In Great Britain also the universities have been potent, and, in addition, its leisure class has contributed greatly. Here prior to 1876 we had no university in which research work was adequately encouraged, and we have had no amateurs comparable to those of Great Britain. Professor Pickering found[8] that of the 87 scientific men who were members of at least two foreign academies, 6 were Americans as compared with 17 from Prussia, 13 from England and 12 from France. In so far as our scientific production is so measured, the reference is to a generation ago, when our universities were only beginning to develop and research work was only beginning to be appreciated. But it is a striking fact that of the six distinguished

[8] THE POPULAR SCIENCE MONTHLY, October, 1908, and January, 1909.

Americans, three are astronomers; and astronomy is the only science in which thirty years ago the facilities for research work in this country were equal to those of the leading European nations. Of the remaining three, two have not been engaged in teaching, and the third has been practically freed from teaching for his research work. We may hope that when conditions become as favorable for other sciences as they have been for astronomy, the United States will assume leadership in scientific productivity.

In order to answer questions such as the extent to which the scientific work accomplished in America is due to native endowment, whether such endowment is general or specific, how far it occurs in family lines, what part of those endowed are able to prove their ability, the influence of education and example, the effects of opportunity, encouragement and rewards, it is necessary to make a study of individual cases. A large mass of material is at hand concerning the relatives of scientific men who have shown scientific productivity or have attained distinction, but these data are not in order for publication and should be supplemented by answers to many enquiries. In the meanwhile the writer may say that it is his opinion that while we should welcome and support a eugenic movement tending to limit the birth of feeble-minded and defective children and encouraging the birth of those that are well endowed, it appears that under the existing conditions of knowledge, law and sentiment, we can probably accomplish more for science, civilization and racial advance by selecting from the thirty million childen of the country those having superior natural ability and character, by training them and giving them opportunity to do the work for which they are fit. We waste the mineral resources of the country and the fertility of the soil, but our most scandalous waste is of our children, most of all of those who might become men and women of performance and of genius.

Eugenics may become the most important of all applied sciences, but at present its scientific foundations must be laid by the study of comparative genetics, on the one side, and the study of human conduct, on the other. There is more immediate prospect of improving our civilization than our germ plasm. It is easier to decrease or eliminate typhoid fever by hygienic measures than to attain racial immunity, although this is not equally the case for tuberculosis and still less for cancer. We can increase to any desired extent from the existing population by proper selection and training the number of scientific workers in the United States. The number capable of exhibiting genius is limited, but many of them are lost through lack of opportunity. It is our business, it should be our principal business, to improve our civilization by giving opportunity to those who are fit, while at the same time investigating the conditions which will give us a better race.

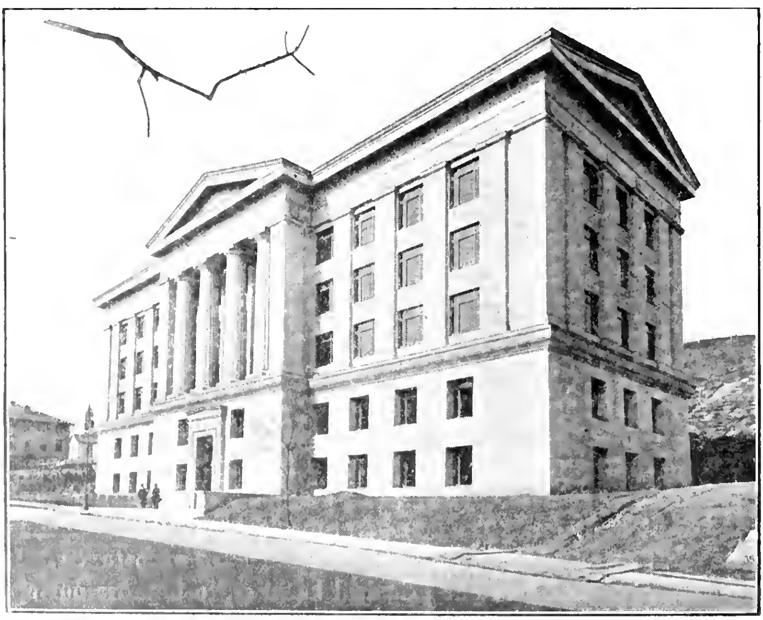
(*To be continued*)

THE PROGRESS OF SCIENCE

THE MELLON INSTITUTE OF INDUSTRIAL RESEARCH

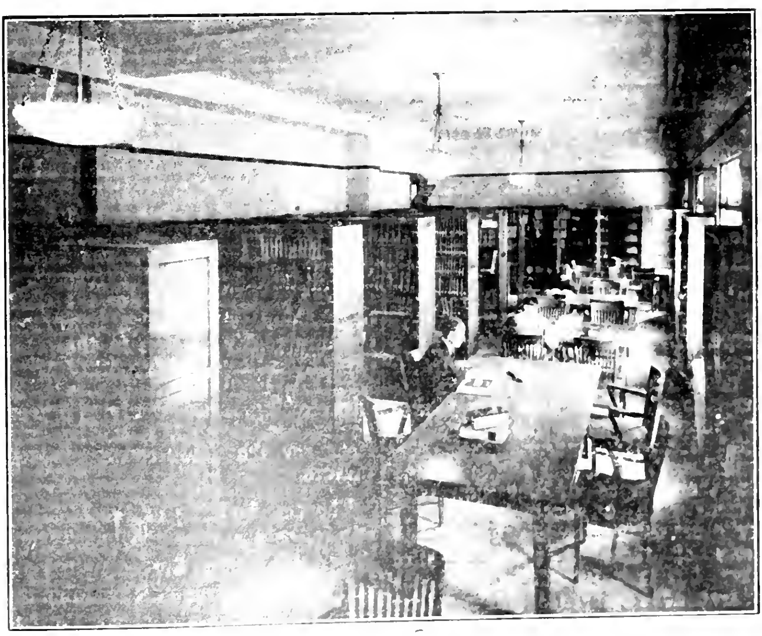
EIGHT years ago Robert Kennedy Duncan, then of the University of Kansas, proposed, and later carried into effect, a plan for industrial fellowships in chemistry which embodies a new method of education and research. According to this plan, an industrial firm established temporary research fellowships at a university, and the students appointed to them by the university carry on work, which may be of value to the firm, under the auspices of the professors. Patents or improvements which result belong to the firm, but the scientific work may later be published for the benefit of science, and the students may have some share in profits that result and an opportunity of regular employment by the company. This plan was continued by Dr. Duncan at the University of Pittsburgh, and resulted in the Mellon Institute of Industrial Research recently dedicated.

Dr. Duncan died while the building was in course of construction, but had the satisfaction of seeing this method of cooperation between the university and research, on the one side, and industrial establishments and practical utility, on the other, placed on a permanent basis. It has been extended beyond the institution and the science for which it was inaugurated. Thus there is just announced an extensive plan inaugurating business fellowships at New York University with the cooperation of a number of leading commercial houses.

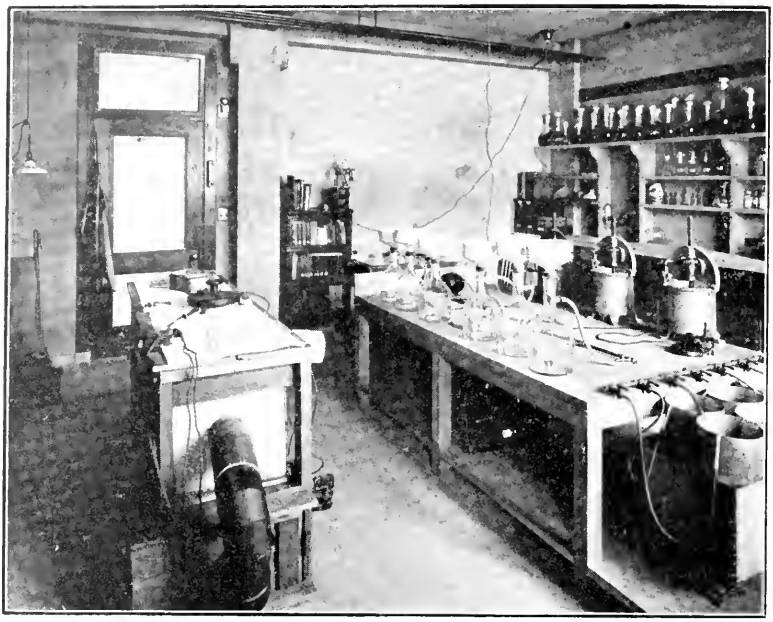


THE NEW BUILDING OF THE MELLON INSTITUTE OF INDUSTRIAL RESEARCH AND SCHOOL OF SPECIFIC INDUSTRIES OF THE UNIVERSITY OF PITTSBURGH.

THE OFFICE OF THE DIRECTOR OF THE MELLON INSTITUTE, DR. RAYMOND F. BACON.



[illegible] the M[illegible] Institute.



A VIEW IN ONE OF THE THIRTY-EIGHT RESEARCH LABORATORIES which have been finished and assigned in the New Building of the Mellon Institute.

The Mellon Institute has its own endowment and board of trustees, but is educationally an integral part of the University of Pittsburgh. It is the gift of A. W. Mellon and R. B. Mellon and has been erected at a cost of $350,000. The donors have also provided $40,000 a year for five years for maintenance. At the dedicatory exercises Dr. W. J. Holland, director of the Carnegie Museum and formerly chancellor of the university, said:

In a certain sense, Mr. Chancellor, this building is a memorial to Robert Kennedy Duncan. On one side of the entrance is a bronze slab inscribed with the name of Thomas Mellon; on the other side of the entrance is a bronze slab inscribed with the name of Robert Kennedy Duncan. But, Mr. Chancellor, this splendid edifice erected upon the campus of our university is more than a cenotaph. It not merely commemorates the names and careers of those of whom I have spoken, but it is intended to serve as the seat of advanced inquiries along scientific lines, which will tend to the promotion not merely of intellectual culture, but of industrial success, and that not merely in this great "workshop of the world," where it is located, but throughout the land. In creating this institution our dear friends have been actuated by a high and intelligent purpose. Large experience in great industrial enterprises has taught them the importance of chemistry and physics in their application to the industrial arts, and they feel that, wonderful as has been the progress made within the last century, there are untold mysteries in nature which have not yet been revealed, but which, if uncovered, are capable of being used for the welfare of mankind. And so they have created and are to-day placing in the custody of you, gentlemen of the board of trustees, this institution, which is capable of becoming, when wisely and intelligently administered, a mighty implement for the advancement of human welfare.

The new building of the Mellon Institute, as shown in the accompanying illustration, is a five-story and attic building. The basement contains seven rooms: the main storeroom, the boiler room, the electric furnace room, a

heavy apparatus room, a room equipped for low-temperature work, the machine shop and a kitchen. On the first, the main floor, are located the general office, the directors' suite, the office of the editorial department, the library, the office and laboratory of the assistant directors, the assembly hall, a special apparatus room and a dark-room laboratory. The second and third floors each contain ten large research laboratories and nine small ones; the fourth floor, which is not finished, will contain an identical number of laboratories as soon as the growth of the institute warrants its completion. At the present time twenty-three fellowships are in operation and forty research chemists are engaged in a study of the variety of industrial problems under investigation at the institute.

ATOMISM IN MODERN PHYSICS

In an address at the spring meeting of the National Academy of Sciences, Dr. R. A. Millikan, of the University of Chicago, reviewed the discoveries of the newer physics. In abstract he said:

Atomism in modern physics begins with Dalton's discovery in 1803 of exact multiple relationships between the combining powers of the elements. Out of this discovery grew the whole of modern chemistry. The second tremendously important step was taken in 1815 when Prout pointed out that the atomic weights of the lighter elements appeared to be exact multiples of that of hydrogen, thus suggesting that hydrogen was itself the primordial element. The periodic table of Mendeleef added support to such a point of view, and Moseley's recent brilliant discovery through the study of X-ray spectra of a new series of multiple relationships, represented by a consecutive series of atomic numbers from 13 up to 79 with every number except three corresponding to a known element, is another most significant bit of evidence. When we add to this three other facts, namely, (1) that each member of a radioactive family, like the uranium family, has been definitely shown to be produced from its immediate ancestor by the loss by that ancestor of one atom of helium (which is almost equal in weight to four atoms of hydrogen), (2) that in an atomic weight table the differences between the weights of adjacent elements are in almost every case exact multiples of the weight of the hydrogen atom, the characteristic helium difference 4 appearing with extraordinary frequency, and (3) the fact that the introduction of the concept of electromagnetic mass, and the consequent discovery of the inconstancy of mass, open several ways of explaining the slight departures in the exactness of the multiple relations between atomic weights pointed out by Prout, it will be evident that modern science may well feel fairly confident that it has indeed found in hydrogen the primordial atom which enters into the structure of all the elements. All this is merely a very modern verification of very ancient points of view.

But modern physics has recently taken a more significant and more fundamental step than this, for it has looked inside the atom with the aid of X-rays and other ionizing agents, and has there come upon electrically charged bodies, whose inertia or mass is wholly accounted for, at least in the case of the negative elements, by their charges This discovery marks the fusing into one another of two streams of physical investigation, namely, the molecular stream and the electrical stream. A necessary condition for the justification of this last step was the bringing forward of indubitable proof that the thing which has heretofore been called electricity is after all, contrary to Maxwell's view, a definite material substance in the sense that it exists in every charge in the form of discrete elements; in other words, that it too like matter is atomic or granular in structure. Such proof was found in the discovery in the oil drop experiments of even more exact multiple relationships between all the possible

charges which can be put on a given body than Dalton had ever discovered between combining powers or Prout between atomic weights or Moseley between X ray frequencies. The greatest common divisor of this series of charges is then the ultimate unit or atom of electricity which has been named the "electron." New evidence that it is indeed a universal and invariable natural constant will be brought forward and a new determination of its value will be presented.

It is obvious that as soon as we could assert that these electrons are found in the hydrogen atom it was necessary to suppose that a single hydrogen atom contains at least two such electrons, one positive and one negative, and as a matter of fact the evidence is now strong that it consists of exactly two. This twentieth century has then discovered for the first time a new subatomic world of electrons, the constituents of atoms.

All this is definite and probably permanent. But atomic conceptions in more or less vague form have also begun to invade the one remaining field of physical investigation, namely, the field of ethereal radiations. The most significant of recently discovered facts in the domain of radiant energy are these:

(1) Ethereal radiations when absorbed by matter, if they are of high enough frequency, will detach one and only one electron from a single atom. (2) The energy transferred to this electron from the ether wave is independent of the intensity of the incident radiation. (3) It is also independent of the kind of matter from which the electron is taken, but (4) it is exactly proportional to the frequency of the ether wave which detaches it.

These facts are stated in an equation set up tentatively by Einstein in 1905, and arrived at by him from the standpoint of a modified corpuscular theory of radiation. New proofs of the exactness of Einstein's equation will be presented and the evidence for and against Einstein's conception will be discussed. Whether the conception ultimately stands or falls, it appears probable, at any rate, that an equation has been obtained which is to be of no less importance in future physics than Maxwell's equation of the electro-magnetic field, and which seems destined to undoors to the understanding of the relalock for the physicists of the future the tions existing between matter and radiant energy.

SCIENTIFIC ITEMS

We record with regret the death of Dr. Frederick Winslow Taylor, of Philadelphia, past president of the Society of Mechanical Engineers, known for his inauguration of methods of "scientific management"; of Dr. Edith J. Claypole, research associate in pathology in the University of California; of Dr. A. A. W. Hubrecht, professor of embryology in the University of Utrecht; of Professor Stanislaus von Prowasek, head of the zoological department of the Hamburg Institute for Tropic Diseases; of Sir George Turner, distinguished for his work on the rinderpest and on leprosy, from leprosy, contracted during research work to discover a cure for the disease, and of Lady Huggins, widow of Sir William Huggins, the distinguished astronomer, and known for her scientific work.

Miss Davy, niece of Sir Humphry Davy, has presented to the Royal Institution, London, a bust of the great chemist executed by Samuel Joseph in 1822.

The Royal Astronomical Society has by a vote of 59 to 3 passed a resolution approving of the admission of women as fellows and associates of the society, and requesting the council to take all necessary steps to render their election possible.

THE POPULAR SCIENCE MONTHLY

JUNE, 1915

A HISTORY OF FIJI

BY ALFRED GOLDSBOROUGH MAYER

THE CARNEGIE INSTITUTION OF WASHINGTON

PART I

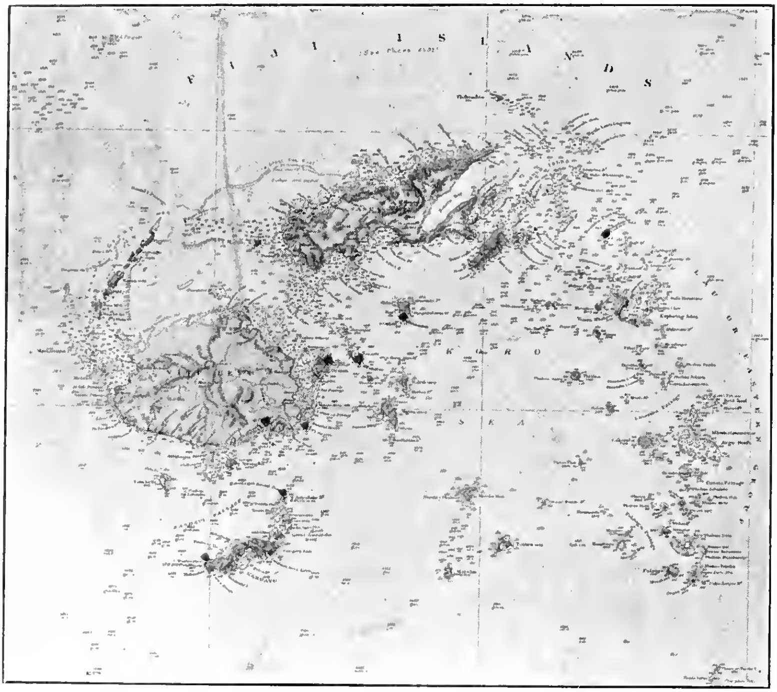
Of all the island groups in the outer Pacific none surpass the Fijis in their rare combination of beautiful scenery and interesting natives. The islands are upon the opposite side of the world from England, for the meridian of 180° passes through the centre of the group crossing the island of Taviuni. The islands lie from 15° 30′ to 19° 30′ south of the equator, and are thus south of the region of perpetual trade winds, but still well within the tropics, the center of the group being about 1,000 miles due north from New Zealand.

That dauntless old rover, Abel Jansen Tasman, discovered them in 1643 on his way from Tonga in the *Heemskirk* and *Zeehaan* and named them "Prince William's Islands" and "Heemskirk's Shoals." After this, they were all but forgotten until July 2, 1774, when Captain James Cook sighted the small island of Vatoa in the extreme southeastern end of the group. The natives fled into the forest upon the approach of his boat, and he contented himself by leaving a knife, some medals and nails in a conspicuous place. Finding many sea-turtles in the region, he named his land-fall "Turtle Island," and then departed from the Fijis never to return.

In May, 1789, Captain Bligh sailed through the group in the small open boat in which he made the voyage of 3,600 miles from Tonga to Timor, this feat being celebrated in Byrons's poem "The Island." He was pursued by two canoes from Waya Island, and dared not land nor hold any communication with the natives. Later in 1792, Bligh again sailed among the Fijis, this time while in command of the man-of-war *Providence*, and in 1796 Captain Wilson cruised among the islands upon his missionary voyage in the *Duff*. Thus gradually the group became known to Europeans; but remained uncharted until 1840, when the United States Exploring Expedition, under Wilkes, made a survey of the region. Indeed,

the oldest detailed accounts of the islands and their inhabitants is that given by Wilkes in the third volume of his narrative of the expediton.

Counting isolated rocks, the archipelago is composed of about 270 islands having a total area of 7,400 square miles, or nearly the same as that of Massachusetts. Two of the islands are far larger than the others, Vanua Levu (the great land) being about 100 miles long and 25



miles wide, and Viti Levu (Great Viti) being 80 miles long and 55 wide. Kandavu and Taviuni have not one twentieth the land area of the two larger islands, and all the others are much smaller, so small indeed that only about 80 islands of the group are large enough to be inhabited.

Geologically speaking, the Fijis are old and the volcanoes which gave rise to them have long ago subsided into their final rest. Yet even to-day there are reminders of more active times in an occasional earthquake, or the hot springs of Ngau or of Savu Savu valley and other places on Vanua Levu, or the pumice, which at times rises to the surface of the sea and is cast ashore at Kandavu. The islands were once much larger and higher than they are to-day, for tropical rains have washed the soft lavas into the surrounding sea, leaving here and there pinnacles of hard basalt towering upward in fantastic castellated forms and imparting a romantic beauty to the view which is surpassed only

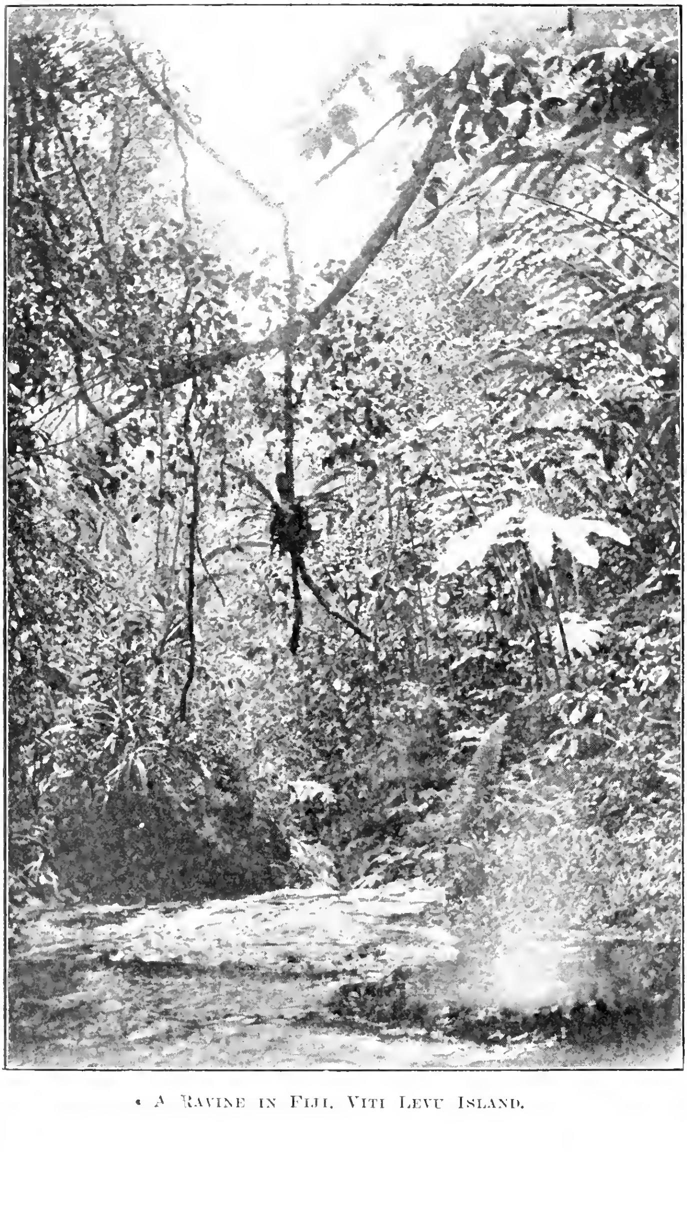
in the Society and Marquesas Islands. The little island of Kobu near Nairai is a mass of volcanic rock, 90 feet in height, and is so strongly magnetic that a compass placed upon its summit is deflected 85°.

In the Fijis the erosion has gone so far that most of the old volcanic rims have disappeared. Totoya and Thombia are, however, beautiful cup-like craters, their centers now being harbors encircled by crescent-shaped ridges, and there are a few fairly well-defined craters among the mountains of the larger islands. Indeed, at Kambara a small volcano has in recent, but still prehistoric, times broken through the elevated coral reef, but no native myths speak of volcanic eruptions.

The Fijis are much older than the large islands of the Hawaiian group or than some of the Samoan and Tongan islands, the volcanoes of which are still active. Indeed, in the interior of Viti Levu plutonic rocks and slates are found attesting to the considerable age of this island, allying it to such land masses as New Zealand or New Caledonia, which are partly volcanic and partly continental in character. Thus the Fijis differ from the simple volcanic tumuli which constitute the Hawaiian, Samoan, Society and Marquesas islands. In Hawaii and Tahiti we find great central volcanic peaks, from the summits of which deep valleys radiate outward to the sea, but in Fiji the large islands have been formed by fusions between many adjacent volcanic cones, and in later times the erosion has gone so far and local elevations and depressions have been so frequent that the landscape is broken and wholly irregular.

Indeed, the islands have not been passive during all the ages in which the rains have worn them down, for there have been depressions, and also great upheavals here and there, as at Vanua Mbalavu, where the old coral reef is now a bold precipice of overhanging castellated crags towering far above the waves that dash at its feet. This old coral rock is cavernated and, at least one place along the shore, at Black Swan Point, on Vanua Mblavu Island, one may enter through a small cleft in the precipice and find oneself in a spacious chamber several hundred feet in height, with veil-like sheets of stalactites sparkling in the dim light that wanders inward through some hidden rift far up in the vaulted roof. A deep pool of wonderfully clear ocean water lies within this shadowy retreat, and brilliant blue and green fish flit butterfly-like through their natural aquarium, the floor of which is carpeted by graceful sea-whips, and slowly creeping crinoids with long feathery arms.

Many other islands also exhibit elevated coral reefs, which in some cases, as at Vatu Vara, have been lifted nearly 1,000 feet above the sea, and, near Suva, the hillside is full of fossil sea-shells and corals. We can see that the islands were once much larger than they are to-day, for nearly every one is encircled by a coral reef several miles out to sea, which marks the contour of the old coast line. Indeed, at Astrolabe



A RAVINE IN FIJI, VITI LEVU ISLAND.

Reef, we find a small cavernated volcanic rock, the last remnant of an island, surrounded by a broad lagoon which is edged on its seaward side by a rim of coral reef over which the surf breaks ceaselessly. In other cases, as at Cakau-momo, the island has washed away and only the submerged reef is left to mark its former site.

The very land has age and life and is vanishing before our eyes. In the past the islands were higher, but now the loftiest mountain peaks are not over 4,600 feet.

The earthquake waves, which must have accompanied many of the changes of elevation, may have given rise to the myth of a deluge, which under varied forms is found almost universally among the natives of the tropical Pacific, but we need not resort to such remote or hypothetical occasions for the establishment of the flood-myths, for almost every year between February and March there is a severe storm in Fiji, and recent floods of the Rewa River are now the topic of native song.

It is to the rich tropical forest which clothes them that the Fijis owe their charm. Even the sheltered relatively dry leeward slopes of the mountains are fairly well covered with forest, but on the sides which face the southeast trade wind the vegetation crowds into every nook and cranny of the precipices even to the summits of the highest peaks. So copious is the rainfall that the Rewa River is larger than any in England and is navigable for fifty miles above its mouth, its width being fully three thousand yards, where it meets the ocean.

The beauty of the mountain valleys produces an impression which time can not efface from the memory. Great Tahitian chestnuts, the "Ivi" (*Inocarpus edulis*), with buttressed trunks, tower far above like columns of an ancient temple garlanded in green, while overarching the rock pools of the stream are the rich brown stems of tree-ferns crowned by emerald sprays of nature's lace-work. Broad-leaved caladiums cluster in the water, and the clambering Pandanus winds in reptilian folds over the high boughs, where dainty orchids nestle far from the reach of all below. Now and again there is a flash of color, where some cockatoo or parrot or brilliant butterfly appears only to vanish in the leafy maze, or here and there through a break in the canopy a furtive beam of sunlight penetrates to gild the greenness of the shade. One looks in vain for dead trees and old decaying logs for all is life in this luxuriant growth. Death has here no lasting place, for termites and ants and a host of parasitic plants set hungrily upon all that weaken, and the dying trunk shrinks into other greenness and passes phoenix-like into other life. Wilkes spoke truly when he said of the islands, "So beautiful was their aspect that I could scarcely bring my mind to the realizing sense of the well-known fact that they were the abode of a savage, ferocious and treacherous race of cannibals." To-day there are

Canoes at Kambara Island, Fiji.

no cannibals, and one is safer in "dark Fijia" than in the streets of any civilized city.

An extraordinary number of the forest trees of the Fijis furnish food for man. Such are the bread-fruit, which grows to be 50 feet high, with deeply incised glossy leaves, sometimes almost two feet long. The Malay apple, or kavika (*Eugenia*), grows to a great height and bears a delicious fruit, which, when ripe, is white, streaked with delicate pink, and most refreshing and rose-like to the taste. The cocoanut palm clusters in dense groves along the beaches, the long leaves murmuring to the sea breeze as they wave to and fro, casting their grateful shade upon the native village. Of all trees none is more useful to tropical man than the cocoanut. In time of drought it provides a life-sustaining drink, its leaves serve to thatch the sides of houses and its nuts become drinking cups, or provide oil or food; its wood serves for manifold purposes; its terminal bud is the celery of the tropical epicurean, and the sap from its flower-stalk provides an intoxicating beverage. Indeed, to do justice to its uses would lead us so far afield that we must perforce desist. Curiously, the cocoanut thrives only on the lowlands near the ocean, and flourishes best where the sea-spray settles upon its leaves, or even where its roots sink beneath the level of the salt water. Very rarely one sees a cocoanut palm growing upon the mountain side at Tahiti, up to 800 feet above the sea, but this is exceptional. Bananas and the wild plantain (Fei) grow luxuriantly in the forest, as do also oranges, lemons, limes, shaddocks, guavas, alligator pears, the papaw, mango and many other smaller shrubs and vegetables. Indeed, from remote times the natives have cultivated the soil, and their principal farinaceous food to-day consists in the yam (*Dioscorea*), which becomes from four to eight feet in length, and in the dalo, a caladium, which grows in swampy places. In time of harvest they often bury the breadfruit, dalo or bananas in pits lined thickly with leaves and covered with earth and with stones to foil the pigs. Treated thus, the fruit ferments and may remain for months before being cooked and eaten. Famine is indeed all but impossible in the high islands of the tropical Pacific.

In the rich soil of the broad Rewa valley sugar-cane is cultivated extensively. Cotton becomes a perennial tree in Fiji and produces an exceptionally good quality of boll. Delicious pineapples grow on the less fertile soils, and coffee thrives on the mountain slopes. Indeed, had the Fijis but a market for their produce, they would outstrip Hawaii as centers of agricultural industry.

Even in savage days the natives delighted to cultivate flowers, and the chiefs wore garlands of blossoms around their heads as do the young men and maidens of to-day. It was by means of the flowers that they

knew the months, for the scarlet blooms of *Erythrina* marked the season for the planting of crops. June was heralded by the "tombebe" flowers along the shore, and when the ivi with its violet-scented flowers bloomed in the forest, the natives watched, knowing that it was nearing November when upon the morning of the moon's last quarter the water over the reef would be crowded by myriads of the Mbalolo worms swimming only to burst and shrivel with the rising of the sun, thus casting forth their eggs into the sea, after which the worms, emptied of eggs, sink as mere translucent skins to die upon the bottom. This was the great feast of the Mbalolo, the New Year's Day of former times, when bearers would be despatched to carry the cooked worms nicely wrapped in leaves to far-off chiefs among the mountain valleys.

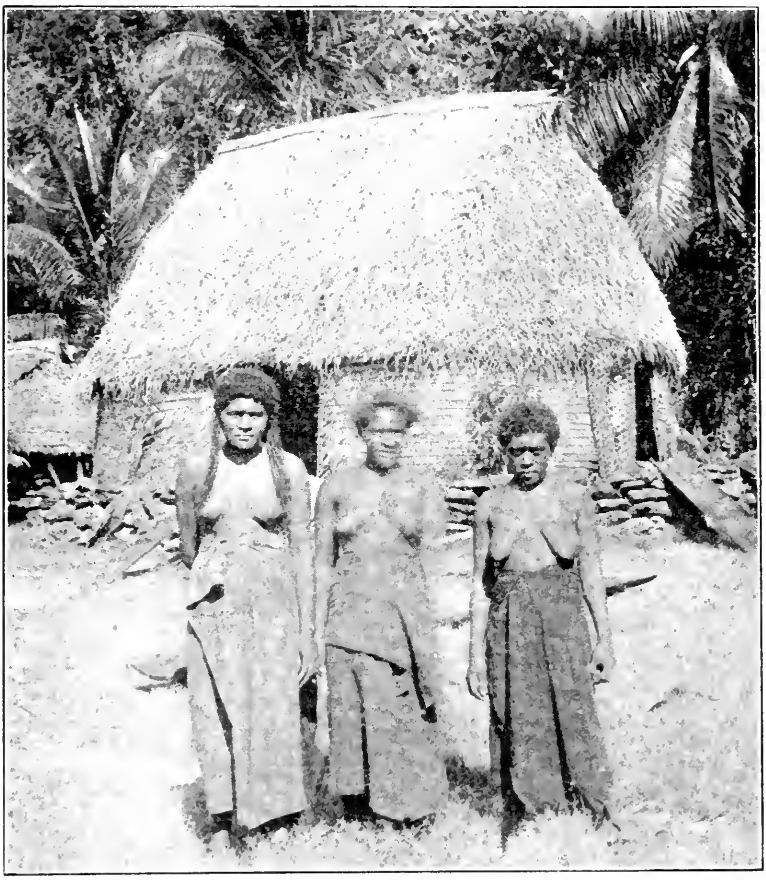
A Maiden of Kambara, Fiji. Type of the Viti-Tonga race.

Once from an old man I gathered a myth of the Mbalolo to the effect that long ago their ancestors were sailing over the sea, while one of the sea-gods guarded the canoe and each day sent food in the form of the Mbalolo, but one old man, fearing it might not be continued, collected more than was required for the day and hid it beneath a mat. Whereupon the god visited the canoe and detected the Mbalolo through the odor arising from its decomposition. In a rage, he swore never again to provide food for the ingrates; but the old man taunted him, saying that the real reason was he had lost the power to cause the worms to appear. Thus, in order to show that he still had power to produce it, the Mbalolo is permitted to swarm only upon the mornings of the last day of the October, and especially of the November moon. Accordingly, October is called *Vula i Mbalolo leilei* (the moon of the little Mbalolo) and November *Vula I Mbalolo levu* (the moon of the Great Mbalolo). In Samoa, this worm is called Palolo from *Pa*, to burst,

and *lolo*, oily, referring to the oily appearance of the water when myriads of the worms burst and cast forth their eggs.

I suspect this myth to be of recent origin, for it bears a suspiciously close resemblance to the manna story in the Bible. Moreover, the old Fijian mythology asserts that their original ancestors were created in Fiji and did not sail over the ocean to these islands. It is remarkable how quickly a new myth may arise among a simple people. Certain floods which occurred within the century have passed into mythology, and one of the mountain tribes has a song of the marvellous manner in which sugar is made at the recently established sugar mill on the Rewa river. A tower of Babel myth has arisen since the conversion to Christianity, and, in Tahiti, a recently originated folk story tells of the creation of the first woman *Ivi* from a bone of the first man.

The Fijians are of mixed stock. Their dark brown skin, thick



WOMEN OF FIJI. The long uncut locks indicate that a woman is unmarried.

NATIVES OF KAMBARA ISLAND, FIJI.

mop-like heads of hair, broad noses, and full lips betoken Papuan ancestry of remote African origin, and probably the earliest inhabitants were of purer Negroid blood than those of the present, for there has been a constant admixture with the Polynesians, who, being good navigators, have peopled the remote islands of the outer Pacific. For ages this admixure has been checked through the practice of the Fijians of killing and eating strangers who were stranded upon their shores, and it is interesting to see that it is only in the small islands of the Lau group of the Fiji archipelago that a decided mingling of the Papuan and Polynesian elements is observed. These Lau islands are set one after another, like the leeward isles of the West Indies, in a long sweeping crescent along the eastern edge of the archipelago, and are only about 270 miles west of Tonga, hence the Tongans, under their great chief Maafu, overran them, killing the men and capturing the women,

and producing a tall, fine-featured, brown-skinned "Vititonga" race, far superior to the negroid peoples of the western islands of the Fijis.

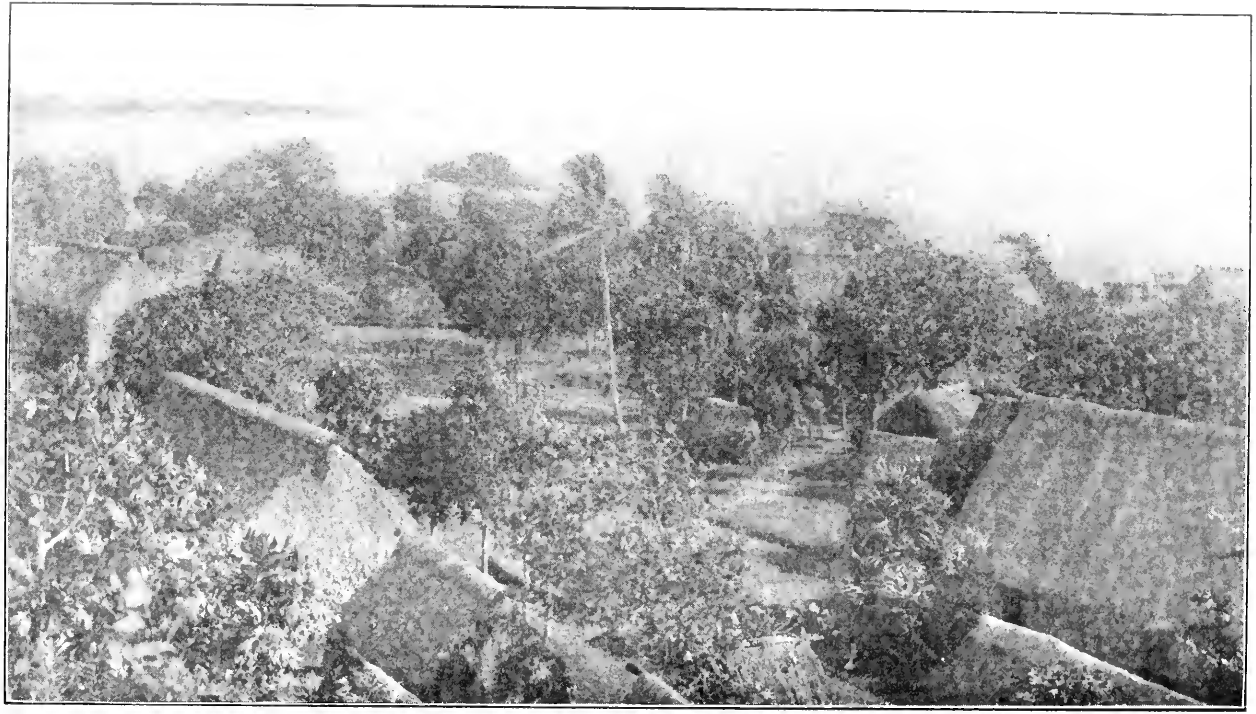
In Fiji, as elsewhere in the Pacific, the strongest natives live along the shore where coral reefs and cocoanuts afford abundant and varied food. At times these shore tribes welcomed the coming of Tongans among them, for they are far better navigators and more intelligent than the Papuans of ancient Fiji, and they taught the art of canoe building. Indeed, pigs and chickens and certain vegetables are thought to have been introduced by this back wave of Polynesian immigration from Tonga.

Among the mountain valleys of Viti Levu one may still see traces of the stunted, sooty-skinned, long-armed, mop-headed negroid race of old Fiji, while in the eastern parts of the group and along the fertile coasts the natives are superior both mentally and physically. The average height of the chiefs is fully six feet, they stand superbly erect, no student's stoop disfiguring the proud shoulders of these noblemen of nature's making. The skin is rich bronze-brown, the lips full, but not protrusive, the nose not especially flattened, and the hair alone remains African and grows into a huge stiff mop which they periodically cover with lime, causing it to lose its black color and to assume a tawny brown-red hue. The eye lacks the languid softness of the Polynesian's and is small, swine-like and often bloodshot, imparting a cruel aspect to the visage.

Yet, withal, the native grace and unconscious dignity of these superb people, especially those of chieftain's rank, produces a profound impression. Physically they seem to be a finer race than we, yet they lack the endurance of the Caucasian, and soon succumb to prolonged exertion, or fall a ready victim to disease. Thus the measles in 1875 assumed the character of a veritable plague, more than one quarter of the population perishing, while in many villages the children starved, and the dead were devoured by hogs, for none were left to bury them.

Yet we must come to the tropical Pacific to see how beautiful the human form may be. As Wilkes wrote, "I have scarcely seen a finer looking set of men than composed the suite of Tanoa" (King of Fiji); and Miss Gordon Cumming spoke truly when she said that no English duchess bore herself with greater dignity and graciousness of mien than did the ladies of the royal family of Mbau.

In many another trait do they show their kinship to the universal feminine. Wilkes attempted to entertain the Queen of Rewa and her maids of honor on the *Vincennes*, but nothing seemed to please, and the party was evidently drifting into failure until, upon a whispered word from the Queen, all became animated and lively expressions of delight changed the entire tone of the afternoon. It transpired later that the Queen had commanded her suite to "act as if pleased."



MBAU, FIJI, from the hill above the town, 1899.

Their scantiness of attire serves but to reveal the beauty of their forms. Indeed, we must recall the fact that even in cannibal days the Fijians would never expose the entire body, for such immodesty would have merited death at the hands of the chief, and in 1827 the natives of Levuka sent off a deputation to protest to Captain Dumont d'Urville against the indecency of his sailors in entering the ocean stripped of clothing. Dress has little or nothing to do with morality; indeed, among savage people the more clothing they are forced to assume the lower do their morals decline. Dressed in his simple waist-cloth, the Fijian is ready at any moment to seek the deep pools of some cool mountain stream in which to bathe. As civilization introduces clothing, so does this practice of swimming decline, and the once cleanly native becomes the prey of filth-diseases. Fortunately, the British Governments of Papua and Fiji have not insisted upon the hat, shirt and trousers for the men, or the ugly "mother hubbards" for the women, which the missionaries have forced upon the natives of nearly all other groups in the Pacific, to the detriment of both health and morals.

As James Chalmers, the great missionary to Papua, wrote in 1885[1]

> Syphilis and strong drink have received the blame for the deterioration and extinction of native races, but I think the introduction of clothing has done much in this direction. To swathe their limbs in European clothing spoils them, deteriorates them, and I fear hurries them to premature death. Put excessive clothing with syphilis and strong drink and I think we shall be nearer the truth. Retain native customs as much as possible—only those which are very objectionable should be forbidden—and leave it to the influence of education to raise them to purer and more civilized customs.

The Polynesians of Samoa, Hawaii, Tahiti and New Zealand had a lyric history sung by priests and sagas which told of days when the ancestors of their chiefs were gods, but the Melanesian race has little of this mythology, and there is no "history" in Fiji, where, according to Wilkes, all are said to have descended from a single pair, whom the gods made black and wicked and to whom they gave but little clothing. Then the gods made the brown-skinned Tongans who behaved better and to whom they gave more clothing, and, last of all, the white men were created, and these were well behaved and were given much clothing. There are apparently no myths of ancient migrations, and the people are said always to have lived in Fiji.

There is no history of the group as a whole, for war was the one chief object of Fiji, and each little district was forever suspicious of its neighbors. Indeed, to such a degree did the Fijians carry their zest for war that two men would walk abreast, never one behind the other, for the temptation of the man behind to club his companion might at any moment become irresistible. It was death to pass behind a chief or to

[1] "James Chalmers, His Autobiography and Letters." pp. 255–256, by Richard Lovett. London. 1902.

cross his shadow, or the shadow of his house. No Fijian revenge was assuaged until the enemy was eaten; indeed, so natural does this seem to them that a high chief asked me in a casual manner whether we of the United States had eaten the Spaniards whom we had killed during the war of 1898.

A detailed account of the ceaseless native wars is given by the Reverend Joseph Waterhouse in "The King and People of Fiji" and by Williams in his fascinating "Fiji and the Fijians," and they are records of treachery, murder, cruelty and vice, unrelieved by the narration of a single fight for principle or an act of mercy or chivalry. In all history there have been few instances of higher courage, fidelity and devotion to their creed than those furnished by the lives of the early missionaries to these islands, and nowhere in the Pacific has conversion accomplished more good and in the process done less harm than in Fiji.

Tradition states that in former times the island of Mbengha was dominant in native affairs, and its chiefs still style themselves "Qali-cuva-ki-lagi," "subject only to heaven"; finally, however, the chief of Rewa conquered Mbengha and slaughtered nearly all its inhabitants, and then, in 1800, the village of Verata on Viti Levu became dominant in Fijian affairs. At this time, Mbanuvi, who had succeeded his father Nailatikau, was the head chief of the town of Mbau, but he soon thereafter died and was succeeded by his son, Na Ulivou (The Hot Stone).

Mbau is a little island, not a mile in width, which lies off the south-eastern corner of the great island of Viti Levu, of which indeed it is a mere outlyer, being connected with the mainland at low tide by a natural causeway. Yet this insignificant islet of a single hill, surrounded by shallow mangrove flats and reefs, was destined to conquer nearly half of Fiji.

In the south seas that chief who first obtained the aid of white men in the use of firearms gained a rapid and terrible ascendency. It so happened that in 1809 the armed brig *Eliza* was wrecked on the coral reef off Nairai, which was a dependency of Mbau, and the natives plundered the vessel. A Swede, named Charley Savage, and three companions made their way to the shore, and Savage was the first white man to come to Mbau. Here it is not improbable that he would have been killed and eaten in accordance with Fijian custom respecting the shipwrecked, had he not bethought himself of a musket which had been left on board, and requested the natives to search for it. They found it, built into the palisade surrounding a native village and soon Na-Ulivou saw in Savage and his musket the means to "world-wide" conquests.

Verata, which was only eight miles from Mbau, was then the strongest power in Fiji, dominating the villages for about ten miles along the shore of Viti Levu, but Mbau, aided by this base imitator of Champlain, soon stripped it of its dependencies, leaving to its chief only his native village. Savage caused the natives to construct an arrow-proof sedan chair, within which he remained comfortably seated firing through an opening, and this contrivance was carried into battle while he terrified and slaughtered the impotent enemies of Mbau. For his share of the spoils of conquest Savage demanded women, and he is said to have acquired a hundred wives. Na-Ulivou heaped honors and titles upon him and gave him for his principal wife a chieftainess of the highest rank, but her children were strangled for reasons of state polity, so that after his death he was survived by but a single daughter.

For two years Mbau enjoyed a monopoly of firearms in Fiji, and

RATU BENI TANOA AND HIS WIFE ADI CAKABAU IN THEIR HOUSE AT NAVUSO, VITI LEVU ISLAND, FIJI, IN 1899. They are cousins, both being members of the Royal Family of Fiji. The screen is a large piece of Taviuni tapa.

conquered all the neighboring islands and overran the eastern and southern coasts of Viti Levu. Finally, in 1813, the Mbauan conquests were pushed as far as Mbua in the southwestern part of Viti Levu, where in a fierce battle the ammunition of Savage and his white companions became exhausted, and they were forced to retreat to a small island in the river, where they were surrounded by thousands of howling enemies engaged in devouring the bodies of the fallen warriors of Mbau. Savage went to the water's edge to treat for terms of surrender, where he was captured, drowned and eaten, and his leg bones made into sail needles, while other parts of his skeleton were ground into powder to be drunk in Yaqona.[2]

In 1814, Na-Ulivou and his warriors again came to Mbua with a great fleet of war-canoes, and wreaked terrible vengeance upon those who had killed their champion Savage. For long years after this no native would pass the spot where Savage died without first plucking some leaves and casting them upon the ground; for, as Williams says

> the Fijian peoples with invisible beings every remarkable spot: the lonely dell, the gloomy cave, the desolate rock, and the deep forest. Many of these he believes are on the alert to do him harm; therefore in passing their territory he throws down a few green leaves to propitiate the demon of the place.

In the South Seas the most dreaded ghost is that of the man who seeks revenge for having been murdered and devoured.

Early in his reign a powerful conspiracy arose against Na-Ulivou, but he drove the rebel chiefs from Mbau and also from Rewa, whither they had retreated, and finally he pursued them to Somo Somo on Taviuni, whence they fled to the distant island of Lakemba, whither he met them in a great sea fight and they were utterly annihilated. After this, Na-Ulivou assumed the title of Vunivalu (root of war), and he reigned the greatest chief in Fiji until his death in 1829.

Rewa, however, remained independent of Mbau, and indeed until the group was annexed to Great Britain these two villages were rivals almost constantly at war.

In about 1804 a number of convicts who had escaped from Australia settled upon Rewa and were protected by its chief, and the aid rendered by these reprobates was sufficient to prevent Mbau from conquering Rewa. Even in Fiji, where cruelty, treachery, cannibalism and ferocity were considered virtues, some of these men are still remembered as monsters of iniquity. In a few years they had nearly all killed one another or fallen in native wars, and only one, Paddy Connel, called Berry by the Fijians, survived until 1841, and served as guide, pilot and interpreter to Wilkes during the surveying operations of the United States Exploring Expedition in 1840. This man became thoroughly Fijianized, having the traditional hundred wives and forty-eight chil-

[2] The "kava" of Samoa.

dren, and so great was his influence that the chief of Rewa would always roast and eat any man who incurred Connel's displeasure. Indeed, if native accounts are to be trusted, Connel was himself a cannibal. All travelers in the Pacific will agree that the most vicious savage is not the native, but the degenerate white who has violated his birthright to civilization.

When Na-Ulivou of Mbau died, he was succeeded by his brother Tanoa (kava bowl), who reigned for twenty-three troubled years, and died a cannibal and a heathen in 1852.

Soon after Tanoa's accession, a powerful faction in Mbau decided to make war upon Rewa. This Tanoa was desirous of preventing, for he was Vasu (nephew) to Rewa, his mother having been a chieftainess of this place. This gave him the right to seize and appropriate to his own use almost anything he desired from Rewa, where he was treated with a respect bordering upon religious adoration; for whenever he visited his mother's district the people would salute him with clapping of hands and shouting "Hail good is the coming hither of our noble lord nephew."

Naturally he was well disposed toward Rewa and he treacherously aided them while ostensibly prosecuting the war. This enraged the Mbau chiefs and they drove him into exile, where he remained five years, but finally in 1837 with the aid of his son Seru (afterwards called Thakombau) he reconquered his native village, and in a fiendish orgy dismembered his captives, roasting and eating their tongues, arms and legs while they still lived.

Beneath every post of his house in Mbau a slave was buried when his new canoes were launched they were rolled into the water over the bodies of living victims who, after being crushed, were roasted and eaten, and when the canoe took to the water men were slain upon its deck so that it might be baptized in blood. When he sailed, he ran down all in his path, often capturing the victims for his cannibal feasts, for it was the rule in Fiji that all who were upset or wrecked were regarded as sacrifices to the gods. Indeed, the gods of Fiji were themselves cannibal ghosts of dead chiefs and fed upon the spirits of those who were sacrificed.

Wilkes gives a description of the coming of Tanoa to a conference held upon the U. S. S. *Vincennes* in August, 1840;

> The canoe of Tanoa, the king of Mbau, was discovered rounding the southern point of the island of Ovalau; it presented a magnificent appearance with its immense sail of white mats; the pennants streaming from its yard denoting it as belonging to some great chief. It was a fit accompaniment to the magnificent scenery around, and advanced rapidly and gracefully along; it was a single canoe, one hundred feet in length, with an outrigger of large size ornamented with two thousand five hundred of the Cypræa ovula shells; its velocity was almost inconceivable, and every one was struck with the adroitness with which it was managed and landed upon the beach.

Often when Tanoa returned to Mbau from his murderous raids children yet alive were to be seen suspended by an ankle or wrist from the yard-arm of this canoe, and so common was this practise that such were called in derision Manu-manu-ni-latha (birds of the sail).

The later years of this inhuman monster were disturbed by dissentions and by the rebellions of his sons. Yet when he came to die he smiled with his last breath when told that five of his wives were to be strangled to accompany him into the world beyond.

Throughout his reign, Rewa and Mbau were almost constantly at war, but every now and then Tanoa would command the Rewa chiefs to come to Mbau to beg pardon for their temerity, which they always did, even if victorious.

Tanoa lived to be nearly if not quite eighty years of age, a rare occurrence in Fiji, for they believed that as they were at the time of death so would they be in the world to come. Thus doubly did they dread the infirmities of age, and people who passed middle life commonly requested their nearest relative and friends to strangle or bury them alive. Thus died the great chief Tuithakau (king of the reefs) of Somo somo, an event of which the missionary Williams gives a detailed and graphic description. Tuithakau was described by Commodore Wilkes as

> a fine specimen of a Fiji Islander; bearing no slight resemblance to our ideas of an old Roman. His figure was particularly tall and manly and he had a head fit for a monarch. He looks as if he were totally distinct from the scenes of horror that are daily taking place around him, and his whole countenance has the air and expression of benevolence.

In August, 1845, this old aristocrat became feeble after prolonged illness, and one day he announced to those around him that the time of his death had come. Two of his wives were then adorned in gala attire and strangled by their kindred, while the old king was covered with charcoal pigment, the chieftain's turban of masi placed upon his head, and a string of whale's teeth around his neck. Then the chief priest blew two blasts upon his triton shell, and after an interval turning to the old king's son he said "True the sun of one king has set, but our king yet lives." Then the aged man was carried out through an opening torn through the wall of the house, as is the custom to-day at Fijian funerals, and they placed him upon the bodies of his two dead wives who lay upon the mats within the grave, and as the earth was thrown over him he was heard to cough beneath the ground. Sixty of his subjects then cut off their little fingers, fastened them upon reeds and thrust them into the thatch along the eaves of the dead chief's house. So respected was this custom of burying the aged that for a whole year at Somo Somo the missionaries heard of but one natural death of an adult, and Wilkes says that among over 200 natives at Savu Savu he saw not one over forty years of age.

(To be continued)

THE LIBERAL ARTS AND SCIENTIFIC MANAGEMENT

By Professor GRANT SHOWERMAN
UNIVERSITY OF WISCONSIN

THERE are no doubt a great many easily attainable data which the general public or its individual members, in the effort to improve civic or industrial affairs, may well employ some one to collect and set in order for them. There may even be some justification for the existence of the professional investigator, though there is the greatest danger that as a class and in the long run he will do more harm than good by seeing too much or seeing awry.

It is safe to say, however, that not even the professional investigator will ever fathom the mystery of the college professor—and of course I mean him of the less demonstrable sort, the professor of liberal arts. Man is an ingenious animal, and the professional investigator is a superman, but there are limits to human capacity.

If the professional investigator ever compiles an intelligible report on the college professor, it will be either because he himself is a college professor, or because he takes the word of the college professor; and even then it will satisfy neither professor nor public.

It would be surprising indeed if a college professor—a real college professor, I repeat, one of the useless kind; not one of the kind whose services are so easily translated into money, and who are really nothing but business men—it would be a great surprise if a real college professor ever undertook a "survey" of his fellows. He knows too much about the nature of their calling. Next to the ministry, or even beyond it, the profession of liberal arts is removed from the rough business of life, and occupies itself with the affairs of the mind and soul. The religious life and the intellectual life have always set their own standards, and always will. Both of them know and feel what they are aiming at, and they alone really know. The world may indeed fix the manner and amount of college receipt and expenditure, but the purposes and methods and results of liberal education have never been susceptible of "scientific management," and never will be. The world's inability to set standards, or even to comprehend them, is proved by its very attempt to investigate. Investigation is really an avowal of the intention to force the liberal arts into the moulds of worldly business. Were the intention to succeed, the result would be, not liberal education, but worldly business.

It would be quite as surprising if the college professor attempted to give "scientific" answers to the questions of the professional investigator. The last thing that either the professor of liberal arts or his disciples would attempt is a scientific or "practical" demonstration of

his efficiency. He is unable to demonstrate it, in the ordinary sense, even to himself, to say nothing of the world.

Add to these reasons that even if the college professor could demonstrate his importance, he would be the last man to do so in the blanks of a questionnaire, and you have my excuse for presuming to speak for him when the professional investigator is already in the field.

I

The college professor's work may be considered in several aspects.

The first of these aspects is the one most familiar to the general public, and is consequently the basis on which his work is usually estimated. This is the classroom aspect.

But even this aspect is only superficially understood. The profession of teaching is thought of as an occupation in which a certain amount of previously acquired knowledge and method is applied in routine. It is like the goldsmith's occupation, or the dentist's, or any other calling with fixed office or working hours. The professor of liberal arts himself is thought of as a person who spends a minimum of time in routine work, has a great many unemployed hours during the school year, and during a very long vacation is absolutely free.

The fact is, however, that the average college professor spends almost as much time in class room and office as the average clerk in the employ of corporation or state. Count in the time he is in the laboratory and office before and after classes—in faculty and committee meetings, in conferences with individual students and colleagues—and you will find him employed more hours than the clerk. Count in the time he spends after these duties are done—in reading and correcting themes, exercises and notes, in reading and refining on the lessons and lectures of the next day—and you will find him far exceeding the limits of the carpenter's and bricklayer's day, and even that of the common laborer.

Nor is this all the time and effort he expends. The professor's work is never out of his mind. Coming or going, eating and drinking, the college and its affairs are always with him. If he is not talking of them or doing them, he is thinking of them. The Saturday which he is supposed to give up to recreation is more likely than not a busier intellectual day than the others. The Sunday which he is supposed to devote to worship and meditation is also given in no small part to reading and thinking which inevitably center about the college work. His very recreation becomes, in spite of him, a part of the college business. He walks with a friend, and they discuss college problems. He reads with his wife, and they choose their magazine articles and books with a view to the effect upon his college work. He engages in physical exercise, and it is for the sake of intellectual efficiency. The significance to him of red blood is that without it he can be neither inspired nor inspiring. And the long vocation—on that, too, he looks with the professional eye. The long vacation is his great opportunity for the reading and writing

that routine work has made impossible during the year—for the renewal of his intellectual storage batteries for another year. More likely than not, he does less reading and writing than he desires because he knows that his physical and nervous batteries also need re-storing.

The physical and nervous expenditure of the college professor's life is not usually appreciated. Talk is cheap, we are told, with the implication that it is easy, and there is no denying that to some kinds of people some kinds of talk are both cheap and easy; but the sustained talk of a fifty-minute lecture, or the almost sustained talk of a recitation period, especially if the lecturer or teacher is warmed with enthusiasm, is not a task to be repeated many times on the same day without a manner of exhaustion far different from mere bodily fatigue, and more lasting. It should surprise no one that men and women who spend five days of the week in work of such intensity, and two more in work that differs only in degree, feel at the year's end the need of a prolonged period for recuperation.

The college professor does not measure his time—which means that he also does not begrudge it. And the reason why he does not is that in the main his pleasure coincides with his duty. He gives his time ungrudgingly because he likes to. I do not forget the fine bits of humor about the professor—"a man with not enough brains to be a clerk, and too little muscle to dig ditches." As a matter of fact, he is a college professor because he is fitted for and enjoys the intellectual life, and because he has followed his bent. Almost, if not quite as much as the clergyman, he has been "called." He has not selected his vocation; his vocation has selected him. And almost, if not quite as much, with him as with the clergyman, salary is but an accident of vocation.

The college professor's liking for his work, together with his comparative liberty, is no doubt responsible for the impression that he has an easy time. In one way, the impression is well grounded. He does enjoy a degree of liberty, for his vacations are long and his work elastic. Time does pass rapidly and easily, because he is for a great part of it absorbed in congenial tasks. Of the necessary drudgery of the profession, let us say nothing here. If it is criminal to accept pay for what one likes to do, he is indeed an offender.

But it should not be forgotten by the efficiency zealots that the college professor and his work represent an all-important principle in scientific management. Congeniality of task is a great factor of industrial economy, and the greatest promoter of both the employer's material interest and his peace of mind. The liberal arts professor's critics should remember that actual enjoyment of occupation is a greater stimulus to working well and working long than any office regulation or promise of salary.

The college professor is working hours enough. Not infrequently, he is working too many hours for either his own or the general good. The clear head and the buoyant heart are as indispensable to teaching

as to preaching—one of them perhaps more so—and neither is possible to the jaded man. Should benevolent legislation—or professorial trades-unionism—get far enough to forbid the professor's working more than eight hours a day, or after six o'clock, or with too great rapidity, it is conceivable that in respect at least of buoyancy his work would be improved.

The college professor is working hours enough, and he is earning his salary. I am not going to make a display of statistics here. They could be made to prove a great many things—among them, that it is no wonder college professors marry late, have few children, and seem glad of the opportunity to earn a few dollars outside the college walls. But statistics are always under suspicion of perjury, so it will be just as well, and much simpler, merely to repeat that the professor is earning his salary, and to let it go at that. For my first year's instruction, in one of the many "greatest universities in the world," I received eight hundred dollars and the satisfaction of hard work in fields I liked. One hundred dollars went for books, and I was married. To qualify for this position, I had spent four years as undergraduate and four years more as graduate, two of them in Europe. Salaries may have advanced somewhat during the past fifteen years, but the prices of wives and babies, and other necessities of a really human life, have shown them a clean pair of heels.

This is not a complaint—at least, not an ill-natured complaint. There is no doubt that if college professors in general, especially those in the smaller institutions, were better paid, the level of ability in the profession would be raised. Books, travel and study abroad, are the great means of growth in the intellectual life, and there are very few who can afford them. But there is no great reason for thinking that a rise in salaries on a large scale would have the commensurate effect upon teaching. There may be some truth in the assertion sometimes made that the brightest and most capable young men in college are attracted to the more highly paid professions, with the implication that the teaching profession suffers; but there is not much cause for worry on this account. Any professor of experience will say that among all these "bright and capable" young men there is only once in a while a real *mind,* and that the peculiar combination of mind and soul that constitutes the ideal of the teacher is even more rare; and that the young man who possesses the combination rarely fails to enter the teaching profession—naturally, and not for the financial reason.

It would be a sorry event for liberal education—and for technical education too—if the principles of scientific management were really applied: if the professor's preparation were formally prescribed, if hours were fixed and tasks made absolutely definite, if promotions and salaries were determined as in the business world, and all the worldly ways of inspection, stimulation, and compulsion were introduced. There is already too much of all this—too much talk of "units," of the "instruc-

tional force" and the "educational plant," of "efficiency" and "output," of "investment" and "returns." One university not more than a thousand miles from where I sit has a noon whistle. If things keep on at this rate, some day when it blows, some hungry or time-grudging scientifically managed professor will drop an expensive piece of apparatus, and the state will pay dearly for its whistle.

No one, however, need worry lest this sorry day come in very truth. Teaching is an inspirational calling. Love of the intellectual life is its foundation and its effect. Inspiration may not be handled, weighed, measured, bought or sold. No college professor ever succeeded because he was "managed." The possible loss through irregularity in the college professor's work is nothing compared with the certain loss should he learn to work in the spirit of the clerk or the union man.

II

A second aspect of the college professor is less familiar. I mean that in which he is seen in the larger or richer institutions, where the greater amount of money has made it possible for him to realize more fully the ideals of his class.

It is in this second aspect that the college professor is most freely criticized. The general public, usually in the person of some one with a political or journalistic axe to grind, runs an eye through the columns of the semester program, and is surprised to find a professor scheduled for twelve hours, or ten, or even as few as six.

"Six hours!" exclaims the general public. "But of course that means six hours a day."

"No, six hours a week. Be assured of the incredibly outrageous fact."

The general public is aghast.

"What? Three thousand dollars a year for teaching six hours a week for nine months? Why, that's $13.888888 . . . an hour!"

No wonder the general public is aghast. It was scandalized even before, when told of the professor in the smaller institution who received a smaller salary for four or five times the instruction. If it is the case of a state institution, and the general public pays the professor's salary and owns him, there is likely in these days to be at least the threat of investigation and "general cleaning up." For the public has been educated by the professional demagogue to assume that dirt is normal.

The demagogue does not encourage the public to reflect. It would interfere alike with his pleasure and his profit.

And yet reflection is easy. Like the professor in the small college, the university professor has administrative duties. He is chairman of a large department, perhaps, and that sometimes means oversight of the work of a score of instructors and the expenditure of large sums for books and apparatus. If he is not, he must nevertheless keep office hours, attend meetings and conferences, conduct a correspondence with

teachers' agencies, school boards, and alumni, answer questions, make reports, and perhaps inspect schools. He must attend various association meetings, local and national, whose work is an integral part of his profession. He has social duties which are in reality professional—departmental dinners, the entertainment of visiting scholars and lecturers.

Last of all, he must prepare for the six hours, for which he is there first of all. If the general public would examine only a little more closely, it would perhaps find that all the six hours consisted of lectures, or the conduct of graduate work, and that they required a great deal of writing and an incredible amount of reading. A lecture in the history of the fine arts may involve the reading of two or three recent books. A lecture in science may entail a week's work in the preparation of experimental apparatus. One sitting of the seminar may require the examination of half a dozen technical articles. This kind of work is different from the mere teaching of how to construe a sentence, how to solve a problem in algebra, or how to perform a chemical analysis. The greatest and most depressing burden of the professor with few hours of instruction is the obligation to keep abreast of his subject—an obligation which it is impossible for even the minutest specialist in the longest established subject fully to meet.

If the general public will use pencil and paper after all the facts are in, it will find that, instead of six hours in the week for nine months in the year, the college professor is spending on the average eight hours a day for six days in the week through the whole of the year, and that, instead of \$13.888888 . . . an hour, he receives \$1.201923072692 . . .

This is for expert service in a profession requiring unusually protracted preparation, and involving social relations with the best paid classes of the community. If the college professor were a mere scientific manager of time and money, he would be insane to continue in a profession which never makes him rich, which brings him on the average only a living, and which is frequently a luxury made possible only by independent means. And yet there are those who think that the professor himself should be scientifically managed. What does keep him at work and give him value at all is something incalculable—an internal, driving, not an external, compelling force; and neither scientific management nor trades-unionism has yet learned to deal with internal, driving forces.

III

There is a third aspect of the liberal arts professor's function which is still more imperfectly appreciated by the ordinary public.

The college professor is an expert. Like all other experts, he is the means of contact between the mind of the public and the mind of learning. These two minds are unable to communicate with any degree of ease; the world, with all the business it has to do, can not hope to find

time for the examination and sifting of the immense piles of fact that constitute the great bodies of knowledge.

The professor is an interpreter. He receives, transforms, and transmits. If he is a professor of science, he interprets the world of nature. If he is a professor of art, he interpret's ideals of beauty. Without his services, art and science would be to the general run of mankind "a mere arrangement of colors, or a rough footway where they may very well break their shins"—to use a phrase from Stevenson. If he is a historian, he interprets the past, and the present in the light of the past. If he is a professor of literature or philosophy, he interprets the wisdom, the emotion, and the conduct of human experience. He is a mediator between his own generation and generations gone. He bridges the chasm between the modern and the ancient, the quick and the dead. He is the lens that gathers and brings to a focus the thousand rays of knowledge. He is second only to the artist in helping the race to remember what it has done, and how, and why, and to what purpose. The artist made the records; the professor of liberal arts interprets them.

And the professor of liberal arts is not an interpreter only. He is an apostle. There is an intellectual life, as there is a spiritual, to enter which ye must be born again. The professor is the priest of this life. His great ambition is to bring minds into the intellectual kingdom. He guides, inspires, converts, baptizes, ministers. Outwardly, he is concerned with concrete instruction; in reality, he is much more concerned with the quickening of the mind. The kingdom of the intellectual is within you. To say it once more, the professor's calling is inspirational. If at any time inspiration fails him, nothing so makes him unhappy, nothing is so missed by his students. The tongues of men and angels can not make up for it.

There is a still larger service of the intellectual expert upon which the public rarely reflects. The college professor has a function and a duty beyond the class room, beyond his community, beyond his state. To put it in a word, it is the college professor, first of all, who is responsible for the intellectual standard of the world.

The direct personal contact of the professor with his students is of course one means of his contributing to the world's intellectual ideals. Through the scattering abroad of alumni his ideas are disseminated and his spirit communicated to society in general. But this is only one means.

It is in taking for granted that this indirect contact with the world is all, that the unreflecting are most mistaken. The college professor's work must not be thought of too much in terms of recitation room and students. The professorial class has its ways of reaching the world at large directly as well as indirectly. The liberal arts professor contributes to the intellectual life of his own community in the lectures and

papers which he is so freely called on to give. He carries his message to the confines of state and even of nation. He may be invited to carry it to the great centers of the whole intellectual world. Still further, he contributes by means of the written as well as the spoken word. In the main, the solidly intellectual product of the entire press, whether in technical or popular form, whether in magazine or book, is the work of his hand. Even the lighter product is mostly the work of his disciples.

Add to interpretation, dissemination and inspiration, the duty of discovery. The college professor's function includes not only the increase of knowledge in the individual and the elevation of the intellectual standard in the world at large, but the actual advancement of learning. College and professor alike are not for their own campus alone, but for society in general.

Naturally, the delivering of lectures and the writing of articles and the conduct of experiment and research can not be done by men who consume most of their time and all of their energy in the recitation room and office. This is where the ignorance and narrowness of those who would scientifically manage the professor's time are most clearly manifest. The cry of "students and class room first," like other demagogic cries, never fails to win a measure of applause.

There are two considerations, however, upon which the critics of these activities should be taught to reflect. One is that, as a matter of fact, other things being equal, professors who lecture, write, and engage in research, are better teachers than those who do not. The professor who is not engaged in this way does not grow. Long continued power of inspiration depends upon continual growth, and growth depends upon continual discovery. It may be discovery, for the general intellectual world, of what has not yet been known, or it may be discovery, for the professor himself, of what the world of intellect already knows—the conquest of the intellectual heritage which none of us can possess *without* conquest; but discovery of some sort is essential both to usefulness and happiness, because it is essential to freshness and vigor of growth. The other consideration has already been mentioned—the relation of institutions of learning and their faculties to the world of universal learning.

The college professor with the six hours is not denying himself recreation and health for selfish ends, except as some little craving for distinction moves him. Least of all is he investigating and writing books because he will be paid money for it. He studies and publishes because he is impelled by the law of his being and the ideal of his calling. The intellectual life is, and always has been, a freemasonry. Learning is, and always has been, almost as much as religion, without money and without price. The apostle of scientific management who imagines that it may be dealt with after the manner of a commodity,

is ignorant. The state that attempts to follow his counsel is stupidly, even if unintentionally, illiberal and uncivic.

As to whether the advancement of learning and the elevation of the intellectual standard constitute a benefit to the state, any one who has read of dark ages and ages of enlightenment, or is acquainted with cultivated men and ignorant, or has lived in intellectual and intellectless centers, may settle the question for himself. It is the difference between running water and the stagnant pool.

And further, as to the uses of advanced scholarship in the liberal arts. The public is familiar with the absurdities of the dry-as-dust professor, and takes great credit to itself when it more or less good-humoredly tolerates him. It does not stop to think that the books and articles and lectures which are its own sole means of intelligent thinking about the past and present of nature and mankind are possible only because of the patience and devotion of those same dry-as-dust professors, who have searched out the details of fact from which enlightened conclusions could be drawn. It does not stop to think that knowledge has always proceeded from above downward—which is only another way of saying that not all men can be leaders, and that progress is always a matter of leadership.

Least of all does the public stop to think, while clamoring for the practical and discouraging the liberal arts, that pure learning, learning for the mere satisfaction of the learner, has always preceded applied learning. Necessity may be the mother of invention, but pure science has always been its father, and pure science is dependent for its spirit upon the household of pure learning.

IV

There is still another aspect of the liberal arts professor. So far, it is his active side that we have considered. But his contribution to society lies not only in the services of teacher and scholar. It lies also in his personal qualities. More than the members of almost any other profession or class, he contributes by Being, as well as by Doing.

With the college professor, too, Being is not, as it is in the case of most professions, an accident. It is a duty strictly required of him. The college professor must be clean-lipped and clean-hearted, honest and honorable. In what other calling, except the ministry, does a single instance of scandal involve immediate dismissal? The world is as strict with the college professor as with priest or pastor. "If a man desire the office of professor, he must be blameless, the husband of one wife, vigilant, sober, of good behavior, given to hospitality, apt to teach; not given to wine, no striker, not greedy of filthy lucre; but patient, not a brawler, not covetous. Moreover he must have a good report of them which are without; lest he fall into reproach and the snare of the devil."

Not all the good qualities of the college professor, however, are prescribed. He possesses some characteristics that grow more or less spontaneously out of the nature of his calling. They are not characteristics which he in any way puts on the market; but they nevertheless make his class one which the world in general may contemplate with advantage to society.

He is usually an example of professional and civic generosity. He gladly gives to his work more than the legal requirement of time, he shares his knowledge freely with the community and the world, and he contributes to local religious and civic enterprise proportionally more in time and money than the wealthy professions with whom he is socially ranked. His hardest work, the scholar's research, is done without thought of money. If he takes money for a lecture or other expert service, it is never in the spirit of the ordinary expert. He takes it with something like self-accusation, feeling it an offense against conscience. In the rare, very rare, instances when his pay is more than "nominal," he wraps it up in the term "honorarium" before handling. There is no better proof of his usual attitude toward compensation of this kind than the surprise and sneer of the worldly man when the college professor presents a bill. It is as if a clergyman should charge for funerals. It is a salutary thing for society to have in its midst one class of men who demonstrate the possibility of the uncommercial life.

The college professor is an example of the workman in love with his work, the citizen unenvious, ungrudging, unmeddling, and clean of heart. Old Cato's words on the farmer describe him as well: "They that are occupied in that pursuit are least given to evil counsel." It is a good thing for the state, in these times of asserting rights and complaining of duties, to have also some sons of this sort. It has plenty who are not.

The college professor is a pronounced example of courtesy—courtesy of manners and courtesy of mind. He is tolerant and charitable. The habit of his life is the weighing of evidence. His first impulse is to seek his opponent's point of view. Courtesy with him has no connection with commerce.

His influence is also for cosmopolitanism and internationalism. His is the one class to whom traveling is a business as well as a pleasure. He belongs to national and international organizations, and is likely to have personal and epistolary acquaintances in all the intellectual nations of the earth. His is the one class in America that knows the languages of other peoples, and enters into their souls. As a consequence, his heart and his voice are always for brotherhood and peace.

He is a force for conservatism. His teaching and thinking are concerned with the widening of his own and his students' horizon—abroad in space to foreign lands, and abroad in time to ages past. He realizes as no one else the immensity of geologic and human experience, and the

fallibility of human effort. The habit of looking for permanent values is inbred in him, of disregarding the external and the temporary. To him, "the eternal verities" is no idle phrase. He has a natural distrust of new and over-facile schemes. He is given to contemplation rather than action. He is a brake, a balance wheel, a governor, a partial correction to the shouting optimism of enthusiastic ignorance.

He is a force for idealism. He is exceptionally free from contact with the sordidness of life. His converse in letters, art and history is with the beautiful and the noble in human thought and conduct. His duty involves the constant effort to reintroduce into human life the emotional experience of the past. Imagine the idealism of the liberal arts entirely removed from higher education; you will see life appreciably harder and more sordid.

V

The duty of the liberal arts professor is thus best described as a duty of Being. He must Be master of his subject. He must Be familiar with the general field of knowledge. He must Be intelligent in his thinking and in his feeling—which means that he must Be cultivated. He must Be inspired. He must Be an irradiator of inspiration. He must Be pure in his living.

All he has to Do, according to the standards of worldly business, is to instruct young men and women at certain hours of the day. According to worldly business, too, he should be scientifically managed. He should be made to Do as much as other men, and the effects of his Doing should be concrete and measurable.

But whatever this Doing accomplishes must be conditioned upon the thoroughness of the Being, and Being is not susceptible of measurement. In the same way, the most important result of his instruction, and its greatest value to the student and the state, lies in the Being which is the source of all best Doing in the individual citizen; and this, too, is not susceptible of measurement.

Scientific management applied to the liberal arts—or to any other teaching—is the most unintelligent of self-contradictions. To insist on the college professor's Doing more is to compel his Being less. If society does not want him and his influence, let it abolish his office. If it does want him, it should remember that the application to him and his work of rules from the industrial world would be equivalent to abolition.

The professor who is a failure is taken care of. He is discovered and put in his place—not by regents or trustees, and least of all by a professional investigator, but by his fellows. He is not the real thing. In the case of the professor who is the real thing, the more the talk of Efficiency, the less the Service.

THE CELIBATE WOMEN OF TO-DAY

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THERE were in the United States, in 1910, 8,924.056 women, over fifteen years of age, who were neither married, widowed nor divorced. These single women represent twenty-nine and seven tenths per cent. of all the women over fifteen years of age in the United States at that time. Many of these women have since married or will marry; but at every age there remains a large number of unmarried women facing a life of celibacy. Thus of native-born white women between the ages of twenty-five and thirty-four, thirty and six tenths per cent. are unmarried, while of the same class, between the ages of thirty-four and forty-four, seventeen and eight tenths per cent. are still single. The public school teachers of America, alone, number nearly 400,000 mature women, hardly any of whom are married. Why do they not marry, and what compensations can a life of celibacy bring them?

In the first place, it is a mistake to imagine, as most people do, that the emancipation of women since 1870 has tended to discourage marriage. The contrary is true. In 1890, but sixty-eight and one tenth per cent. of American women of fifteen years of age were married, or had been married; in 1900, this proportion had risen to sixty-eight and six tenths per cent.; and in 1910, it was seventy and three tenths per cent. Higher education, industrial independence and increasing participation in social and political life have apparently increased the tendency of women to marry. But why, since they have so rapidly taken possession of nearly everything else, have they not more generally taken possession of husbands?

The widespread belief that there are not enough men to go around is another old superstition. The men have outnumbered the women in the United States at every decennial census since 1820. In 1910, there were in the whole country 2,692,288 more males than females. Of course, this is partly due to the fact that more male than female immigrants come here to work.

But even among the native-born whites, there were in 1910, 922,502 more males than females. In that year there were 102.7 white native born males to each 100 native-born females. Only in Massachusetts, Maryland and North and South Carolina was there an excess of females. Counting only the people over twenty-one years of age, there were 110 males to each 100 females in 1910; and even among the native-born whites there were 106.8 males to each 100 females over twenty-one years of age.

There have always been women living apart from family life, at least during the historic period. For obvious reasons, men have almost universally considered female celibacy a matter of reproach, and they have even invented such makeshifts as child marriage in India and sealing among the Mormons that unfortunate or undesirable women might be spared the disgrace of dying unmarried. At times, a lack of dowry has condemned the least attractive women to live alone; and the offices of religion have imposed celibacy for at least a part of life upon groups like the Vestal Virgins in Rome and for the entire lifetime upon nuns and other Christian recluses. In none of these cases, however, did women choose to live alone because they hoped thereby to realize a fuller life than they could find in the married state. In the religious orders, they dedicated their virginity to the service of the Deity, and at most hoped to profit in the life to come for their loss on earth.

This is the great difference between celibate women of the past and those of the present time. With our enormous number of unattached men, it would be foolish to imagine that the great majority of single women in America could not marry if they wanted to do so. Man proposes, but woman dictates when he shall do it. Why do so many women elect to walk through life alone?

Doubtless the growth in democratic ideals, which has been steadily working among women since 1870, has had much to do with it. Women have ceased to be merely "the sex"; they have become individuals. Under simpler conditions of life, such as prevailed in our colonial period, if a woman found a man of her race, religion and social position, who was personally agreeable to her, little more was necessary to insure a happy marriage. But now a woman seeks fulfillment not only for her personal liking, but for all the qualities of her varied personal life. She has not only racial, religious and social interests, but she has an intelligent attitude towards the whole of life; she has musical, dramatic or literary tastes; she is interested in social justice or in the vested interests of caste; she cares for travel or she desires a quiet home; and in a hundred other directions she is an individual. Such a complex individuality does not easily find its complement. A person who merely likes music can generally find it; a person with a cultivated musical taste must search for music that suits him.

All this uncertainty is emphasized by the examples of marital unhappiness that intrude themselves on every hand. We have in our midst nearly a million divorced people. The deserted wife and mother is one of the greatest and most common problems that confront social workers. Our funny papers find the majority of their humor in deceived and deceiving wives and husbands. The drama and the novel burden us with sex problems. Yellow journalism lives on the tragic

side of married infelicity. Of course, there are millions of happy marriages, but such happiness, like good health, is inarticulate and does not advertise itself in the market place.

Every self-supporting girl must also be deeply impressed with the difference between her own economic position and that of her mother. For years, as a girl, she has seen her father and mother working together as life partners; and she has seen all the net income recognized as her father's personal property. Her mother's relation to the family purse has generally been that of a medieval serf to his lord's estate. Even the house furnishing and the mother's own clothes have often been secured by stealth and indirection. Now the girl has her own pay envelope, and in possessing it absolutely she holds the key to life as she desires it. It is not to be wondered at that a young woman in full possession of youth and health finds it difficult to give up a salary which, even if small, is absolutely her own, to accept a feudal relation to some man's salary, often not much larger than the one she has earned, knowing it must suffice for two and probably for more.

Of course, this feeling fails to recognize the danger of the passing years. With the blindness of youth, it over-emphasizes the value of present liberty. Later, she may see the day when she will realize that she has sold her birthright for a pay envelope. But it is not so much the amount of the income that really troubles the modern woman as it is her personal relation to it. Surely some means might be devised by which a woman could be related to the family income so as to preserve her independence and self-respect as well as that of her husband.

Another difficulty that confronts the young woman of to-day in her search for the altar is her superior intelligence. This is generally less important than it seems, but in a country which worships popular education and where all parents hope to give their children at least a better education than they have had, correct grammar and a speaking acquaintance with Robert Browning and Michael Angelo acquire a value out of all proportion to their power to function in life. When a likely young man comes courting who says, "You and me will go," and prefers the movies to Ibsen, it makes the young woman who aspires to culture question the long evenings of a lifetime.

This is especially true of the young woman who has risen intellectually and economically above her social class. Skilled preparation has given her an income superior to that of the men in the group where she was born; and she has been too busy studying and working to make social connections in the class where she thinks and works. The social emancipation of woman lags far behind her intellectual and economic freedom, so that these young women whom we are considering still move socially in their family planes. The men in that group are too ignorant and too poor to suit her; and the men with whom she works

know her only as a stenographer, a teacher or a journalist. Our last census returns show how widespread this condition is, for except in New England, there is no excess of men in the cities. But in the countryside the excess of men is great, for they have been left behind in the struggle towards larger intellectual and economic independence whch has swept the young women into the towns.

These women, possessing a fairly large intellectual and professional life, often move in a pitifully narrow social circle. The home, as a center for social activity, has been sadly squeezed in our emigration from the country into the city. Friends and acquaintances come less often than in the past to spend a few days with the family. Calls are more formal and brief. Acquaintances less often drop in for a meal; and meantime the older social conditions that limit a woman's initiative in making acquaintances still hold and are broken by young women only at considerable risk.

Even public meeting places are apt to be restricted to one sex. If the girl joins a club, it is a girl's club; if she joins the Y. W. C. A., the young men are a half mile away in the Y. M. C. A. When shall we be wise enough to turn both these institutions into Young People's Christian Associations? And meantime, while the hunting field is narrow the difficulty of selection has increased. A generation ago, as we have pointed out, a girl might hope to find a desirable mate among a dozen acquaintances. Now she needs to look over a hundred young men to find her own.

In the light of this analysis the wonder is not that we have so many unmarried women in America, but that we have so few. Nature has loaded the dice in favor of marriage and she generally has her own way. Many of these young women, however, will never marry. Nuns will continue to vow their virginity to the Celestial Bridegroom; reformers will spend their lives in securing social justice for their sisters and for their sisters' children; professional women will continue to seek fame and service; teachers will fight off the wars of the future, not with submarines and aeroplanes, but with ideas and ideals planted and nourished in young minds. Many other women, with no particular devotion to sustain them, will be held by the charm of pay envelopes and independent latch keys until it is too late; while the accidents of fate will leave many stranded in their struggle towards a complete life.

Meantime there can be no doubt that the most complete life a woman can live, at least between the ages of twenty-five and forty-five, is found in a marriage based on a deep and lasting love; and the same is no less true for a man. What, then, has our modern life to offer to celibate women as compensation for the life they do not attain?

There are at least certain negative values which come to them.

In escaping vital experiences, the woman can at least recognize the fact that she also escapes the anxieties and troubles that are inseparable from family life. She will probably be lonely; but, on the other hand, when she wishes it she can be alone. In writing to a friend, who had lost his little daughter, Cicero says that all men would wish children were it not for the anxiety that they inevitably bring.

To put it more positively, the celibate woman retains her freedom of action. Through study, travel, art, science or society, she may reach a degree of self-realization not always attained by her sister who marries. Into her work she can carry much of the enthusiasm and devotion which, as wife and mother, she might lavish on husband and children.

The desire for service, which lies so deep in the nature of all good women, can often be more fully realized in a life of personal freedom than in one of marriage. At least there may be a different realization of very great value to the individual and to society. Such women as Clara Barton, Susan B. Anthony and Jane Addams have brought gifts of service to mankind far beyond what they would probably have given in their own homes. Each of these women probably recognized her personal loss; but many devoted wives and mothers have also recognized their loss through inability to enter into the wider service of public life. Unto no mortal is it given to live all the possibilities of life.

But more important than any of these compensations we have named is the power we all possess to live life vicariously. Our real living is never in the mere possession and use of things, but in what we think and feel about them. Lower animals live in facts; man lives in his ideas and ideals. All of life's values must be found on the way; when we arrive we are always in danger of becoming unconscious and so losing what we came to get.

This is why art and literature have always had to find their characters in the struggling classes, the poor and the rich. The smug middle classes and the comfortably rich have the facts of existence; but they do not know it. The universal contempt of those who know for such unconscious living finds expression in the terms bourgeoise, philistines and bromides.

On the other hand, struggling and self-conscious groups always attract and interest us. Bohemia is poor; it lacks the facts of prop- [illegible] but it has the most alluring of all festivals and immortal ban- [illegible] Who, that has a soul as well as a stomach, would not turn from [illegible] of facts at twenty dollars a plate, with dull unconsciousness [illegible] people, to a group of dreamers and wits with very modest [illegible] talk at table?

[illegible] lost all the facts of life, fame, money,

the woman; but who that has wandered across the pages of romance with him does not envy him the keen appreciation of life, the realization of its realities, the high and compelling ideal, even against the background of poverty-stricken and often drunken facts. Jean Christophe lived all but his musical life vicariously. The woman he loved was another man's loyal wife; his children were born from other men's passions; his home was wherever he could feel the universe. He lived without the material realizations of life; but who of us would not desert unconscious wealth, houses and homes for such a conscious life?

The poet Dante illustrates in his own life the relative value of facts and dreams, of living life directly and living it vicariously, to a singular degree. He was married and had a family of children, but in all his voluminous writings there is no word of these facts of his daily existence. In his early youth he fell in love with Beatrice; we know very little about her; she married another man; and it is quite probable that Dante never even touched her hand; but she led him through Paradise. Since the poet's death, millions have read and have been shaped by the "Vita Nuova" who have never even heard of the wife and children who were the facts of Dante's life.

If all this be true, then the modern woman who does not marry need not feel that life is closed to her, that having been denied the Garden of Realization she must stand before the gates and weep. When the angel with the flaming sword drove Eve out of Eden he opened the world of work and varied experience to her. Gifted with imagination and desire, she could create for herself new gardens of perfection; and if they were less real than those she had left, they were possibly more vividly realized than was the one where she had slumbered away the days of happiness.

Self-realization through vicarious living, this is the solution to a celibate life for the individual. Joan of Arc gave herself to religion and to her people. Madam Kovalevsky found at least relief for the letters that did not come in the honors that were lavished on her mathematical discoveries. Susan B. Anthony found her realization in the ideal life that was to come to all the women of the world; her sister, Mary Anthony, found a deep and rich realization in serving her better-known sister, who was to her all that home means to most women.

Thousands of our teachers are truer mothers to their children than are the mothers who bore them. In schools, libraries and social centers many fine women are to-day wedded to humanity; they are conceiving new ideals of social justice and are giving birth to opportunity for fuller living that shall bring conscious gladness to millions unborn.

For themselves and for all the higher purposes of civilization such lives may have great worth. Biologically they are lost; for the little

strand of the stream of life that finds lodgment in them ceases with their death. This is a pity; and it is a pity, too, that back of the dream there should not be also the reality. One can not help feeling that the children of Dante and Beatrice would have added something of great worth to the fact of existence.

And that this may come in the future we must remodel our medieval institution of marriage. It must cease to be a political convenience or a religious sacrament and must become a biological truth. We must make it impossible for the state to sanction and for the church to sanctify the marriage of imbeciles and of old men and young girls. Women must be emancipated socially, as they have been emancipated intellectually and economically; and they must be given a larger and more direct share in chosing their life mates. We must put family finances on a basis of equal partnership that will attract self-supporting and self-respecting women. We must provide ample opportunities for young people to meet and know each other and we must recognize the fact that it is always a sin for men and women to live in the close companionship of marriage if they do not love each other.

WAVE WORK ON THE NEW JERSEY COAST[1]

By Professor DOUGLAS W. JOHNSON
AND
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DURING the winter of 1913–1914 three unusually severe storms with violent on-shore winds visited the coast of New Jersey. The first of these, known as "the Christmas storm," attained its maximum strength early on the morning of December 26, and was accompanied by winds which attained a velocity of 123 miles an hour. Professor W. M. Wilson gives the following brief description of this storm in the *Monthly Weather Review* for December, 1913.

> With 13 lives lost and millions of dollars of damage done to property, the terrific wind, rain, sleet and snow storm, which began Christmas night and swept over five states, abated early on the twenty-seventh, leaving a cold snap in its wake. The masters of the *A. C. Rose* and the *Undaunted*, coal barges, with eight seamen, lost their lives when the barges foundered off Forked River, New Jersey. Two men died of exposure and were found in roads near Trenton, New Jersey. A workman was drowned in the East River when his rowboat was swamped. The full force of the storm fell upon that portion of New Jersey which reaches out into the ocean like an elbow. Records at Long Branch show that the wind attained a velocity of 123 miles an hour, the highest ever recorded by the Weather Bureau at that point. Seabright, New Jersey, was the plaything of the ocean. Waves whipped by the gale tore away supposedly floodproof bulkheads, smashed bathhouses, washed away or undermined fishermen's cottages, tore away portions of two big summer hotels, inundated the main streets, and buried railroad tracks under 18 inches of sand, brick, and rock.

The second, or "New-Year's storm," was even more disastrous than the first, partly because the coast had been left in an unprotected condition by the preceding attack. On January 4 the fury of the second storm reached its maximum. Driven by a terrific gale whose extreme velocity reached 120 miles per hour, the waves broke upon the beach with a thunderous roar. Bulkheads which had been destroyed or weakened during the earlier storm afforded no protection for the unconsolidated sand of the beach, and every wave seemed to sweep a little of it out to sea. At Seabright groups of dejected men, soaked to the skin by driving rain and salt spray, stood helplessly by the shore and watched the waves remove the land from under their houses, the houses tip over into the sea, and the waves pound them to kindling wood in the space of a few moments. Others labored to place wooden rollers

[1] The substance of this article appears as part of Bulletin 12 of the Geological Survey of New Jersey.

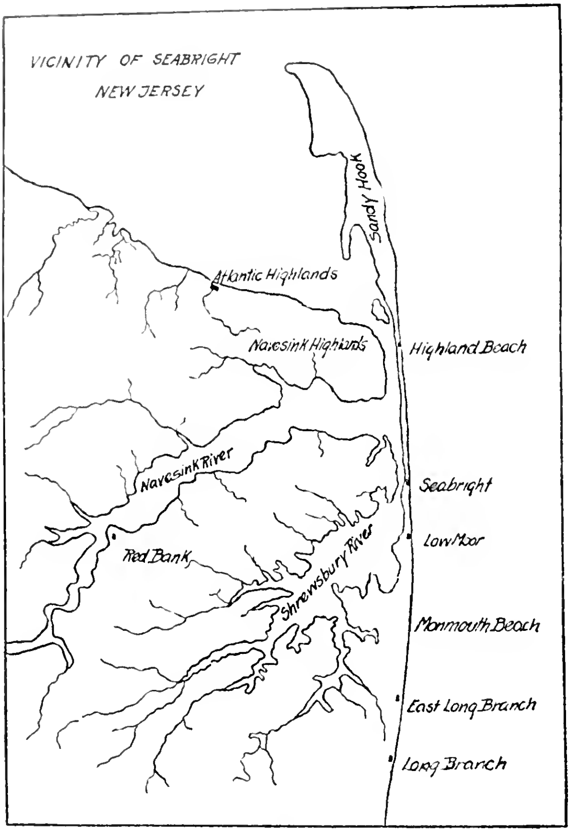

FIG. 1.

under some of the smaller cottages and drag them farther back upon the beach before the waves demolished them: while still others hurriedly removed their furniture in wagons, abandoning the buildings to their fate. A few men stood under the corner of a partially undermined summer residence and struggled in vain to erect a plank bulwark which would stop the advancing sea, while the surging waters nearly swept them from their feet. Crowds of spectators waded knee-deep through the foam blown up from the surf zone by the winds, and watched the water of the sea leap high above three-story dwellings where waves were breaking against some resisting bulkhead. Many observed with [illegible] the attack of the sea upon the beach under the large Octagon [illegible]ed shortly before noon saw the great building collapse and be-[illegible] short time, a tangled mass of splintered wood rising and [illegible] waves. Occasional waves sent water across the narrow [illegible] Seabright were inundated, and the unusually high [illegible] the storm kept many houses on the lower, back

FIG. 2. RUINS OF OCTAGON HOTEL AT SEABRIGHT.

part of the beach surrounded by water for hours. Fortunately, the waters were quiet in the protected bay, and the damage here was slight compared with that on the exposed outer shore, where for a couple of hours a large building collapsed on an average every fifteen minutes. North of Seabright the waves broke through the breakwater which protects the railroad, swept part of the tracks out to sea, and buried other portions under masses of heavy stones.

On February 14 and 15 occurred the third and least destructive storm of the series, when the wind reached an extreme velocity of 116 miles per hour. At this time the waves completed the destruction of the Seabright Beach Clubhouse and certain other structures badly damaged by the earlier storms. In the unprotected state of the shore some further damage has been subsequently accomplished by normal wave erosion during comparatively calm weather, at least one valuable summer residence being demolished in this manner.

The portion of the New Jersey coast which suffered most from the storm waves lies south of Sandy Hook and north of Long Branch. (See Fig. 1.) At the latter place the waves of the sea are attacking the mainland of New Jersey and have cut a marine cliff some 20 feet in height in the seaward edge of the coastal plain. The débris eroded from this cliff has been carried northward by longshore currents and built into a narrow bar which has extended across the mouth of Shrewsbury and Navesink Rivers, and out into the Bay of New York to form the Sandy Hook spit. Monmouth Beach, Seabright and Highland Beach are small towns built upon the bar, and are therefore but a few feet above high-tide level. Formerly the sea broke against the mainland just back of Seabright and at Navesink Highlands; and old marine

cliffs, now grass covered, may be seen at these points. But the bar now lies a short distance in front of these old cliffs, and protects them from erosion. Shrewsbury and Navesink Rivers are really bays of the ocean formed by a sinking of the land or a rising of the ocean level which permitted the seawater to flood pre-existing river valleys. They are "drowned valleys," but not "rivers" in the true sense of the term.

In order fully to appreciate the effects of storms upon the New Jersey coast, it is necessary to keep in mind some of the conditions affecting wave energy. The destructive power of a wave depends in part upon its size, and this in turn partly upon the water depth. Waves usually break and dissipate their energy when they come into water of a depth equal to the wave height. Hence, the deeper the water immediately at the shore the larger the waves which can attack it, and the greater the damage they will effect at that point. It follows from this that the rise of the tide must increase the destructive power of storm waves on the coast, not only because it brings the zone of wave activity farther in upon the shore, but also because the deepening of the water as the tide rises against the steeper upper part of the shore profile permits larger and more powerful waves to break against the shore cliffs. In all the recent storms the chief damage to the New Jersey coast occurred at the high-tide periods, and the citizens worked feverishly during low water to prepare for the violent wave attack which they knew would ensue at the next high tide.

On-shore winds increase the destructive power of the waves in a variety of ways. First of all, they raise the water level by blowing the surface of the sea along the coast faster than the water escapes seaward

HOUSES BEING UNDERMINED FROM REAR.

FIG. 4. UNDERMINING OF SANDBAR CAUSING COLLAPSE OF HOUSE.

along the bottom as undertow. In the second place, on-shore winds, by driving the surface of the sea landward, insure a vigorous undertow seaward; this undertow carries the beach material out to deep water, thereby aiding beach destruction. Vigorous on-shore winds drive in large waves, whereas off-shore winds, no matter how violent, can not form large waves in the immediate vicinity of the shore. During the recent storms on-shore winds raised the high-tide level on the New Jersey coast from one to several feet above its normal elevation, much beach sand was sucked out to sea by the resulting undertow, and large waves were driven upon the shore with terrific violence.

Other things being equal, the greatest damage will occur where the land exposed to wave erosion is lowest. Waves may expend their energy in two ways: in eroding the land or sea-bottom, or in transporting débris. If the land is high, the waves break at the base of a high cliff which sheds much débris into the water as its base is undermined. This débris must be removed by the waves if effective erosion is to continue, as otherwise the cliff would soon be protected by the accumulated waste. Removal of the débris requires much of the waves' energy, and leaves them less competent to wear back the cliff. If the land is low, the low cliff sheds but a small amount of waste upon the shore, the waves quickly dispose of it and energetically continue their landward advance. It is true that the effect of cliff height may be more than offset by other factors, among which the form of the adjacent sea-bottom is important. Of still greater importance for such a region as the one in question is the effect of artificial sea defences, such as breakwaters, bulkheads and similar devices. At Seabright and adjacent

towns the greater damage was suffered where the bar was lowest, or where the defenses were weakest. One of the lowest places on the bar was occupied by the Octagon Hotel, which was completely destroyed (Fig. 2). For a great distance along this low region the shore was cut back from 100 to 150 feet, and the damage to buildings was greater than elsewhere. Both north and south of Low Moor station are unusually high portions of the bar, and here the advance of the sea was not so great, even where the defences were battered down and the houses partially undermined. A maximum of not more than 50 to 70 feet of the shore front was cut away in this region, while the sea gained nothing from the land where the bulkheads remained intact. On the other hand, there are plenty of instances where unusually weak defences failed to prevent fairly extensive erosion of comparatively high areas, and where strong defences saved low areas from attack.

Variations in the character of the material composing a coast necessarily influence the wave erosion. In the Seabright district there is not enough of such variation in the material of the bar to be of any importance. The bar first formed some distance seaward of its present position, and has been pushed landward by the waves. A salt marsh formed back of the bar, and the sands of the latter have been driven in over the surface of the marsh deposits. Hence, the wave-cut cliff on the seaward edge of the bar shows at the base a layer of somewhat indurated black sand, mud and peat, projecting as a little terrace where recently exposed. Above this the yellow-brown beach sands constitute the rest of the cliff, which stands nearly or quite vertical where recently cut into. As these conditions appear to be essentially uniform along the length of the bar under discussion, there is little difference in

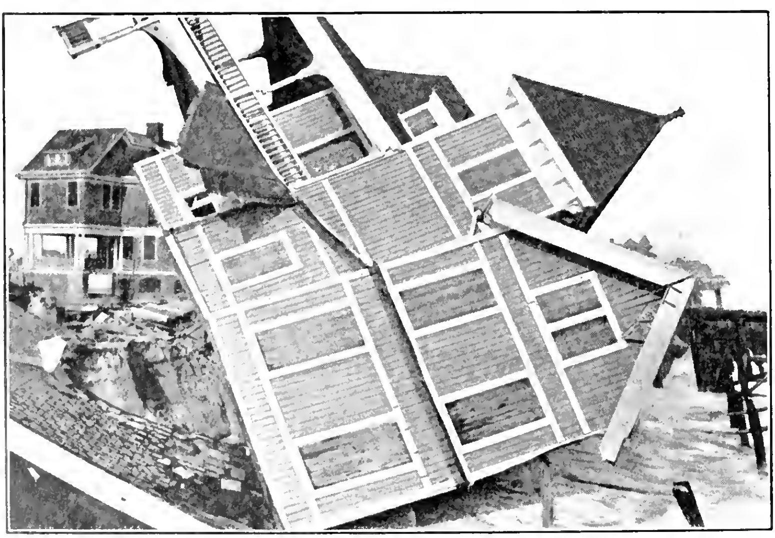

Fig. 5. House Undermined by Waves and Tilted Bodily into Sea.

the rate of erosion at different points which could be attributed to variations in resistance of materials.

An examination of the Seabright shore indicates that the greatest damage to bulkheads resulted from the direct impact of the waves, whereas the buildings suffered most from the undermining of the ground upon which they stood. When it is remembered that ocean waves strike a vertical face with a force of from a few hundred pounds to more than six thousand pounds per square foot, their enormous destructive power may readily be appreciated. Solid blocks of granite have been shattered by wave impact upon the coast of Holland, and it is therefore not surprising that the wooden bulkheads of the Jersey coast should yield to the attack of the sea wherever they were not reinforced by parallel rows of piling with heavy stone filling, or otherwise rendered especially strong. Fig. 7 shows one of the weaker bulkheads in the early stages of destruction.

Most of the bulkheads were surmounted by a broad boardwalk which served to shed falling wave crests back into the sea, and thus protected the cliff from erosion. The force generated by masses of water falling from the great height to which they are projected when a storm wave strikes a vertical wall, may be sufficient to crush such a boardwalk, even if supported by heavy timbers. During a severe gale at Buffalo, New York, many large timbers, 12 × 12 inches in thickness, 12 feet long, and 10 feet between supports, were broken like match sticks by the impact of falling water which had been hurled from 75 to 125 feet into the air by breaking waves. There are several localities in the Seabright district where the demolishing of the bulkheads had been hastened in this manner.

Many of the bulkheads are protected by rows of piling set some distance out in the sea to break the force of the oncoming waves. Even where the sea attack was powerless to break these pilings or to tear them from their positions, the waves passed between the pilings and still retained sufficient force to destroy the bulkheads which presented a more continuous surface to their impact. Fig. 6 shows such a series of protecting piling, which remained largely intact while the bulkhead immediately in front of the house was battered down and the house itself destroyed. Fig. 2 shows a series of pilings surmounted by undamaged bath-houses, back of which the shore has been so badly eroded that the superjacent houses have collapsed.

As a rule, the houses were not damaged as much by direct wave impact as by the undermining of the beach upon which they stood. It is of course true that a building from under which most of the support was already removed by the sapping action of the waves, often received its "death blow" from some extra-large wave; and a building which was once tipped over into the edge of the sea as a result of being undermined was soon pounded to pieces by the waves. The Octagon Hotel

Fig. 6. First Stage of Wave attack on Protected House.

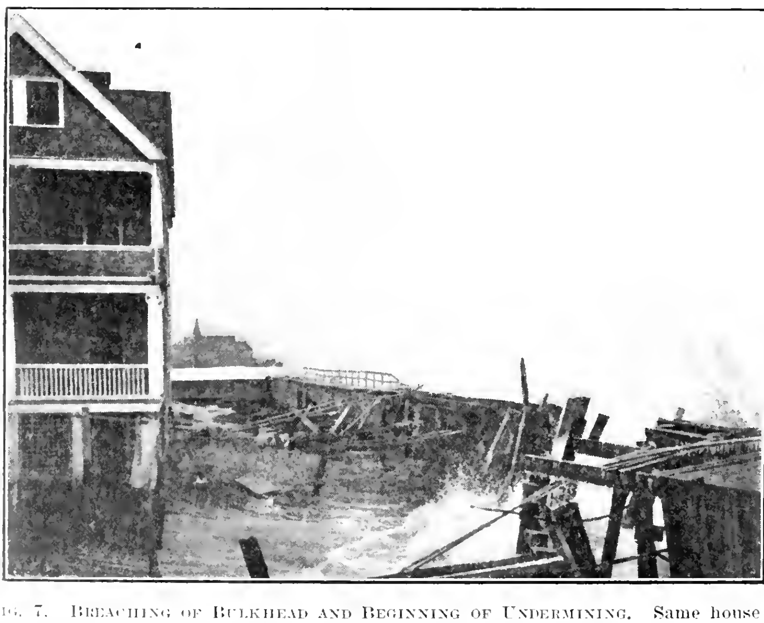

Fig. 7. Breaching of Bulkhead and Beginning of Undermining. Same house as in Fig. 6.

FIG. 8. SANDY FOUNDATION ALMOST WHOLLY REMOVED BY WAVE EROSION. Same house as in Fig. 7.

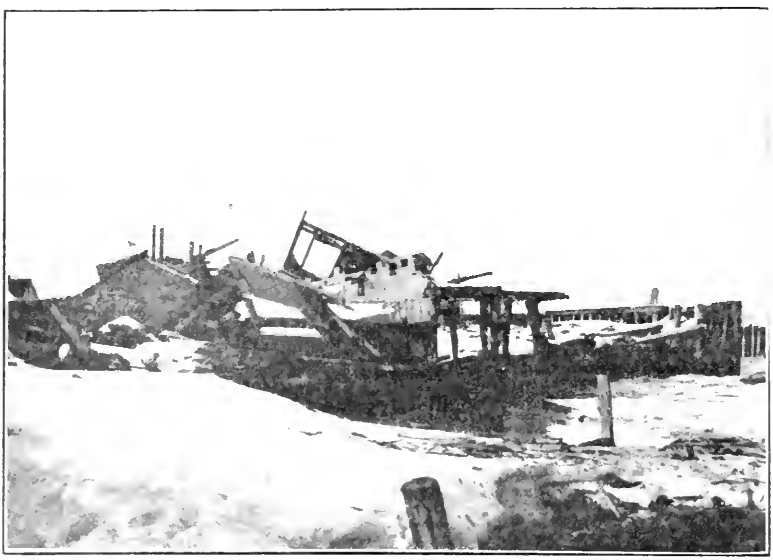

FIG. 9. LAST STAGE OF WAVE ATTACK ON HOUSE SHOWN IN THREE PRECEDING FIGURES.

(Fig. 2) located on an unusually low part of the bar, is said to have collapsed bodily under the blow of one very large wave; while the house shown in Fig. 5 was consumed more gradually after undermining had allowed it to tip over. Indeed, the real damage was usually accomplished independently of direct impact upon the structures themselves. Even where the beach was low and flat, as near the Octagon Hotel in the town of Seabright, the foundations were sapped from under dwellings, allowing them to tip over toward the sea; seldom if ever were these houses crushed in the first instance by the direct impact of the waves. This is clearly shown in the case of the small houses of Fig. 3, which were but a short distance from the hotel, and it is probable that the hotel itself was first weakened by the undermining process. In some cases the houses collapsed piecemeal as the sea advanced under them; or were crushed by the fall when they tipped over into the sea.

Where houses were built on pilings driven into the beach sand the removal of the sand left the buildings precariously supported on the pilings alone until shaken down by the moderate waves of some later storm. The successive stages of this process are well illustrated in Figs. 6–9, which represent four photographs of the same house. In Fig. 6 a small wave has passed through the outlying line of protecting piling and is breaking against the bulkhead built to preserve the house from destruction. Fig. 7 shows that the bulkhead has been breached and that the corner of the house is beginning to be undermined. The next figure represents a still later stage, when the sand has been removed from under most of the house, leaving it supported by the pilings alone. In this condition it fell an easy prey to the smaller waves of later storms, and Fig. 9 shows the final wreck of the building.

One reason for the destructiveness of the undermining action as compared with the direct wave attack is to be found in the fact that lines of piling and bulkheads were together able to break the force of the waves to a large extent, but could not prevent the water of each wave from washing against the foot of the low cliff, removing part of the sand, and carrying it back to sea. In many places the lines of piling, and even the bulkheads, are still in a state of partial preservation, while the cliff back of them is badly eroded and the superjacent houses completely destroyed. The fact that the houses were at a higher level than the cliffed beach was, of course, another factor which rendered direct wave impact less destructive than undermining.

Some have supposed that the active erosion of the New Jersey coast by storm waves is the natural consequence of the gradual subsidence of that coast which has been inferred by some geologists. The evidence for and against the theory of subsidence has been considered by the senior author in various publications, and need not be repeated here. Suffice it to say that the loss of land during the recent storms represents exceptionally rapid erosion of a purely temporary character,

due to an unusual disturbance of the profile of equilibrium by exceptional storms. Most of the material removed from the bar was carried seaward to perfect the proper shore profile of equilibrium demanded by the storms. Part of it, at least, should be carried back to the beach as new conditions demand a new profile. In fact, this process is already in operation, and the shore has been built so far forward in places as to obscure much of the erosive effect accomplished a few months ago. Nothing in the nature of the erosion or of the deposition indicates any change in the relative level of land and sea.

If the land were sinking at the rate of one or two feet per century, the problem of maintaining sea defenses against the ravages of the ocean in the Seabright district would be more serious than it is. The tendency of storm waves to cut into the land would be more marked than at present, and the tendency of marine forces to repair the damage by deposition during calm weather would be less evident. Even as it is the problem is sufficiently serious. Along with the alternate erosion and accretion in the shore zone, due to the varying effect of the marine forces, there is a slow loss of land resulting from the action of currents in transporting some of the eroded debris to deep, quiet waters farther out to sea. This loss can only be arrested by superior methods of artificial protection.

That the damage of which the sea is capable justifies the expenditure of large sums of money in improved sea defences is abundantly proved by the recent storms. The actual value of property completely destroyed in the single town of Seabright was enormous and the suffering of its citizens can not be estimated in money. Many who were unable to bear any loss saw the savings of a lifetime swept out to sea by the merciless waves. It would be difficult to estimate the depreciation in the value of property along this part of the coast alone, a depreciation shared by lands not actually eroded because of the apparent magnitude of the dangers to which they are subjected.

So long as the defence of the land is in a large number of hands and every landowner is practically free to do as little or as much as he pleases toward preventing the sea from gaining access to his property, many must suffer from the failure of a few to take proper precautions against marine erosion. As soon as the sea finds a point of weakness in the defences, it rapidly widens the breach and attacks adjoining property on either side. In some places where the bulkheads in front of one man's property resisted the direct attack, the property was badly damaged by erosion from one or both sides after the sea had entered neighboring lots. Some method of government supervision of marine defences would seem to be the only satisfactory solution of this serious problem.

FERTILIZATION AND ARTIFICIAL PARTHENOGENESIS OF THE EGG

By Dr. J. F. McCLENDON

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TICHOMIROFF, in 1886, was the first to use the term artificial parthenogenesis, referring to acceleration in the development of the naturally parthenogenetic eggs of the silkworm by methods found effective in hastening development in fertilized eggs of the same species. To-day the term is applied to development of eggs not usually parthenogenetic, although a few such might develop in nature under accidentally abnormal conditions.

The exact extent of development that is to be dignified by this term is a matter of dispute, some claiming it should be possible to produce an adult reproductive organism by artificial parthenogenesis. Though Delage obtained two sea urchins in this manner and more than one observer has so produced frogs, none of these reproduced a second generation, a fact not hard to understand on remembering that normally fertilized eggs of many animals have never been reared to maturity and reproductive activity under observation. Loeb considers a swimming larva to be the goal of the investigator. But it is interesting to note that the "swimming larvæ" of the marine worm *Chætopterus,* which he produced from unfertilized eggs, were shown by F. Lillie to be abnormal, unsegmented or poorly segmented eggs that had developed cilia.

We may consider for a moment what signifies development in the egg. The egg of any animal is in the beginning a single cell and undergoes a certain development before normal fertilization. Some animals reproduce parthenogenetically for several generations (*i. e.,* plant lice) and the silkworm eggs, noted before, undergo more or less development if fertilization fails to occur. The eggs of most animals, however, do not segment (produce an embryo) before fertilization. Though in many of these same species (for example, sea urchin) the eggs (during maturation) undergo before fertilization two very unequal cell divisions, resulting in the formation of "polar bodies," the unfertilized egg is generally considered a single cell, since the "polar bodies" seem to have no further part in the formation of the embryo. The positive sign of development in the mature egg seems to be segmentation. We may therefore consider artificial parthenogenesis to be demonstrated by the segmentation of unfertilized eggs which do not normally segment until fertilized.

R. Hertwig was the first to observe the segmentation of unfertilized

sea-urchin eggs, which normally die if not fertilized. Morgan, in 1899, produced segmentation in unfertilized sea-urchin (*Arbacia*) eggs, by immersing them in sea water to which a dry salt had been added, such a solution being called hypertonic sea water, and having a greater osmotic pressure than ordinary sea water. Loeb, immediately afterwards, produced swimming larvæ in sea water made hypertonic by the addition of magnesium chloride. Since then many investigators have studied the subject. Eggs of various animals have been made parthenogenetic by putting them in solutions containing salts, acids or alkalis, sugar, fat solvents, blood sera, alkaloids, or by means of asphyxiation, or by mechanical, thermal or electric changes. The concentration of the solution in which the eggs are treated may be the same as that of the fluid in which they normally live, or it may be of a greater or less concentration.

It has been fairly well demonstrated that the artificial agents—used in producing parthenogenesis—act primarily on the surface of the egg, and R. Lillie supposes they tend to increase its permeability. Loeb recognizes a "superficial cytolysis," the exact nature of which is, however, unknown. When cells containing soluble coloring matters undergo cytolysis, the colored substances come out of the cells. Cytolysis has, therefore, been considered to consist of, or be accompanied by, an increase in permeability of the protoplasm.

The electric conductivity method of Kohlrausch suggested itself to the writer as the best way of settling this question of the permeability of the egg. The principle of the method lies in the fact that an electric current is carried through wet substances by the movement of electrically charged atoms or "ions." If the permeability increases, the ions move faster and the current is greater. The use of this method showed that the permeability increased immediately after fertilization, on the application of agents producing parthenogenesis.[1] These results were confirmed by Gray,[2] who observed further that the permeability decreased again about fifteen minutes after fertilization. Lyon and Shackell[3] observed that the permeability of the egg to certain dyes increased on fertilization, and also that more of the red substances came out of the fertilized than out of the unfertilized eggs. E. N. Harvey observed independently that the permeability of the eggs to certain dyes and caustic soda increased on fertilization. Finally, Glaser has recently concluded from his experiments that fertilization increases the egg's permeability.

There is another proof that the egg of one species (the frog) becomes more permeable to salt on beginning development. The writer

[1] McClendon, *Am. Jour. Physiol.*, 1910, 27, 240.

[2] J. Gray, *Jour. Marine Bio. Assn. United Kingdom*, 1913, X., 50.

[3] *Science*, 1910, 32, 249.

observed that the frog's egg may be made parthenogenetic by means of a momentary electric shock. Unfertilized eggs of a frog were divided into two equal lots, placed in distilled water, and one lot shocked electrically. It was found that three times as much salt diffused out of the shocked eggs as out of the control. Since the salt must have come from the interior of the eggs, the experiment seems to prove that the eggs must have been permeable to it. The shocked eggs began to segment and behaved in other ways as if normally fertilized.

There seems to be no doubt that the permeability of the egg is increased by agents producing parthenogenesis, but just how this influences the egg's development is not absolutely settled, because of the many processes in development which are very far from being solved. Some of these processes have been the subject of numerous investigations. The outward change in form during the segmentation of the egg is caused by changes in surface tension. Granted that fertilization alters the permeability of the egg, it may be that the changes in permeability influence the surface tension.[4]

The unfertilized eggs of sea urchins, frogs and many other animals are surrounded by jelly-like coats, the inner layer of which lies close to the egg. On fertilization, the jelly is pushed out by the perivitelline fluid exuding from the egg, the space occupied by the fluid being called the perivitelline space. The inner layer of the jelly looks like a distinct membrane and is called the "fertilization membrane." Loeb considers its formation of great importance. Biataszewicz has shown that the frog's egg shrinks as this fluid is "secreted." Glaser has observed the same phenomenon in the sea urchin's egg, though the shrinkage is so slight that other observers deny its taking place. Granting that the perivitelline fluid comes from the egg, the increase in permeability would facilitate its migration.

If the jelly be removed from the sea urchin's egg prior to fertilization, no "fertilization membrane" appears. Presumably the fluid is secreted but lost in the surrounding water.[5] Though the membrane helps to protect the embryo, its existence is not absolutely essential, since eggs lacking it (due to the removal of the jelly) have been known to develop. Many observations and experiments have demonstrated to the writer that the tough "fertilization membrane" of the sea-urchin's egg does not exist (at least in its final condition) before fertilization. The increase in permeability allows the escape of the perivitelline fluid which, according to the hypothesis advanced in 1911, interacts with the jelly and forms the "fertilization membrane."[6] Elder, in 1913, came

[4] McClendon, *Roux's Archiv*, 1913, 37, 233.

[5] McClendon, "On the Nature and Formation of the Fertilization Membrane," *Internat. Zeit. f. Physik.-Chem. Biologie*, 1914, Vol. 163.

[6] McClendon, *Science*, 1912, 33, 387.

to hold the same view. E. N. Harvey, though believing that the membrane is not present before fertilization, considers the jelly unnecessary for its formation, holding that the membrane substance hardens on contact with sea water. He admits that unfertilized eggs from which the jelly is removed soon lose their power of forming membranes on fertilization, but says they do not lose it immediately. Perhaps he left a thin film of jelly adhering to the eggs or had not removed the water containing the dissolved jelly. This dissolved jelly may be in time decomposed by bacteria and thus prevent membrane formation. If eggs with jelly remain in sea water fifty-two hours, they do not form membranes on fertilization.

When a sea urchin's egg is fertilized, an increase in the rate of respiration occurs, as shown by O. Warburg. This may be due to some physical change, and is to be expected, since the egg passes from a state of inactivity to one of activity. When the starfish egg is liberated from the body of the female into the sea, it becomes active to the extent of extruding the polar bodies. Loeb and Wasteneys found that respiration was high at the time of formation of the polar bodies in the starfish egg, and continued about the same level, whether fertilized or not. The egg may pass through an inactive stage while in the ovary, with corresponding low respiration. Coming in contact with sea water may stimulate it toward development, with resulting maturation and increased respiration, though the stimulus is not sufficient to cause segmentation. This is in harmony with the fact that much weaker stimuli cause segmentation in starfish than are required by sea urchin eggs. The frog's egg resembles the former and Batallion has shown that the slight prick of a needle is sufficient to cause the frog's egg to segment, while needles have been thrust by the writer all the way through sea urchin's eggs without causing either segmentation or death.

O. Warburg has shown that the respiration of all developing eggs is high, regardless of the methods used to cause segmentation. Respiration is therefore essential to development. Cleavage once started may be slowed or stopped entirely without materially decreasing respiration, indicating that respiration is not a result of cleavage. In order to discuss the relation of respiration to development, it is necessary to go more into detail on the general question of respiration.

Oxidation or Cell Respiration

As is well known, the heat of a flame is unnecessary for the burning (oxidation) of many substances. For example, coal oxidizes slowly in the air, decreasing in weight, a fact which has led to efforts to preserve its fuel value by keeping it under water. Naturally, even slow combustion generates heat, and if the heat be confined, results in spontaneous combustion, *i. e.*, the raising of the temperature to the flame point.

Many substances burned in the body—sugar, for example—may undergo slow oxidation in alkaline solution in the presence of atmospheric oxygen (O_2). In the body, however, it is burned at a faster rate, leading to the conclusion that some other substance or substances are necessary. The search for such substances has led to the discovery of so called oxidizing enzymes, which oxidize many organic substances. It is characteristic of an enzyme, however, that it accelerates but one reaction. For the complete oxidation of grape sugar, for instance, it is supposed that a series of enzymes is necessary. This must remain for some time a supposition, as no pure substance or mixture of soluble substances has been extracted from the body that will completely oxidize grape sugar.

It might be concluded that "life" is essential to such oxidations, but such is not the case. In some instances ground up tissue, free from entire cells, absorbs oxygen and gives out CO_2 at a rapid rate. It is evident that some substances are completely oxidized in the process. The question has been raised as to whether the cell structure which has not been completely destroyed in grinding the tissue be necessary for the oxidation. In certain experiments Harden and McLean failed to observe respiration in juice pressed out of muscles and other tissues. Warburg and Meyerhof ground nucleated red-blood corpuscles with sand, finding that the mass did not absorb oxygen or give out CO_2, whereas the original cells did. Warburg tried to destroy the structure completely by grinding corpuscles in a steel box; with steel spheres rotating at such high speed it was found necessary to cool the box with ice in order to prevent injury to the corpuscles by heat (Barnard & Hewlett apparatus). All microscopic structure was destroyed and respiration ceased.

In other experiments, Warburg ground up liver cells, passing the juice through a Berkefeld filter. The respiration of the juice was but five per cent. of that of the corresponding amount of liver cells. But when a coarser filter was used which allowed the passage of cell granules, the oxidation was found to increase to twenty per cent. of that of intact cells.

If blood corpuscles be placed in water, or in certain solutions, the hemoglobin passes out of them, they become pale and are called "ghosts." This liberation of the hemoglobin, known as "laking," is a kind of cytolysis. Warburg laked nucleated red-blood corpuscles of a goose, finding that respiration continued in the "ghosts," but did not occur in the fluid procured by laking.

Such experiments seem to show that the presence of solid structures, granules, etc., accelerates the respiration, since no substances were eliminated in the process of grinding. It is possible that the solid structures act in the same way, as does finely divided platinum (called platinum

black), which accelerates certain chemical reactions by the condensation of the reacting substances on the surface of the platinum, and their consequent increase in concentration. This process of condensation on surfaces is called adsorption. Warburg supposes that the oxidizing enzymes, oxidizable substances and oxygen are condensed on "surfaces," thus causing the oxidation rate to increase, but what surfaces he means it is difficult to determine, in some places apparently referring to surfaces of granules or colloidal particles, in others to cell or nuclear surfaces.

The adsorption of easily adsorbed substances may retard or prevent entirely the adsorption of others less readily adsorbed. Warburg found that anesthetics reduced the respiration of a mass of cell granules, presumably by driving the enzymes or oxidizable substances from their surfaces. He further observed that animal charcoal in water oxidized oxalic acid to CO_2, whereas if anesthetics were added the oxidation was reduced.

Warburg and Meyerhof found that the respiration of sea-urchins' eggs was not entirely destroyed by grinding with sand, presumably because the cell granules were left intact. They explain it, however, as an auto-oxidation or spontaneous oxidation of lecithin in the presence of iron salts, the oxidation taking place in the test tube. Warburg found iron and lecithin in the sea-urchin eggs and observed that if the total lecithin that could be extracted from a mass of eggs were mixed with a dilute solution of iron chloride, the oxidation was as great as that of the mass of ground cells. From his data we conclude that the mass of ground unfertilized eggs undergoes the same oxidation as does the same mass of cells if it were fertilized before grinding. Warburg interprets this as indicating that the oxidation of unfertilized eggs is due to auto-oxidation of lecithin, and that the increase in oxidation on fertilization is due to increase in structure (surfaces). Since mechanical agitations, however, may cause the eggs to develop, it is possible that the grinding first stimulated each egg to as great respiration as that of a fertilized egg, but the crushing and subsequent mixing of substances reduced the oxidation. It is interesting to note that, whereas unfertilized as well as fertilized eggs absorb oxygen and give off CO_2, ground eggs or lecithin and iron mixtures do not give off CO_2, indicating oxidation is not complete.

Relation of Oxidation to Permeability

R. Lillie supposed the oxidation within the unfertilized eggs to be suppressed by an accumulation of some end product of oxidation that could not escape. It is possible that such a substance might act like an anesthetic and suppress oxidation by adsorption to the granules. Lillie supposed this substance to be carbonic acid, but this is hard to

believe when we bear in mind that the egg may be caused to develop by short exposure to carbonic acid. On fertilization this hypothetical substance would be liberated and could be collected. Glaser fertilized quantities of eggs in a small amount of sea water. On using the same water in which to develop other fertilized eggs, he found it inhibited their development, indicating the presence of an inhibiting substance that came out of the first eggs on fertilization. (Was this CO_2?)

Loeb's "improved method of artificial parthenogenesis" claims two treatments of the eggs to be necessary. They are first to be stimulated to development by use of fatty acid, or some other method, and then exposed to a hypertonic solution. The latter he calls a "corrective agent" and supposes that it changes the character of the oxidation in the egg, since he observes no effect on the rate of oxidation in the developing eggs. It is hard to conceive of such a change in "character," since oxidation means union with oxygen and there is but one kind of oxygen atom in combinations. The oxygen might attack different substances, but in such cases different amounts of heat would be given off, the heat of combustion of fats and carbohydrates, for instance, differing in amount. Meyerhof showed that the ratio of oxygen used to heat produced was the same for eggs in the hypertonic solution as in sea water. When we consider that by the use of either fatty acid or hypertonic solution alone, sea-urchin (*Arbacia*) eggs may be made to develop, it seems unnecessary to devote more time to their combined effect.

Relation of Anesthesia to Development of the Egg

Anesthetics have a depressant action on various cell activities when used in certain concentration. They decrease the respiration and rate of cleavage of sea-urchin eggs (and asphyxiation will cause cleavage to cease). It may therefore be supposed that it is the suppression of oxidation by anesthetics that suppresses cleavage. Warburg, however, caused the almost complete cessation of cleavage in sea-urchin eggs with anesthetics without appreciably lowering the respiration. It may be that the anesthetic acts in one part of the cell (on the surface of the granules) in suppressing oxidation, and in another (on the cell surface) in suppressing cleavage.

In 1909, while measuring the electric conductivity of sea urchins' eggs, the writer observed the decrease in conductivity on the addition of a certain per cent. of chloroform. This experiment was not repeated, but we may imagine that the chloroform decreased the permeability of the eggs to ions. Osterhout, becoming interested in the methods used, modified them for use with plants, and observed a decrease in electric conductivity of certain plants (kelp) when using a certain concentration of anesthetic, indicating that the anesthetic decreased permeability. R. Lillie found that anesthetics might antagonize the action of the pure

salt solutions used to cause eggs to develop, presumably preventing the increase in permeability usually caused by the salt solution.

The use of fish eggs in settling this question presented itself to the writer. It was found that the eggs of the pike will develop in distilled water and are practically impermeable to salts—that is to say, that the salts which they contain diffuse out of them only in such small quantities as to render detection almost impossible even with as sensitive an instrument as the nephelometer. It was found, further, that pure solutions of sodium nitrate increased the permeability of the eggs to chlorides (since the chlorides diffused rapidly from the eggs). The use of anesthetics prevented the effect of nitrates on the permeability of the eggs, so that the chlorides failed to diffuse.[7]

It is thus evident that the problem of parthenogenesis is closely interwoven with fundamental problems of physiology—stimulation, oxidation and anesthesia; and that the final elucidation of parthenogenesis and fertilization must wait on the solution of these other problems. On the other hand, the systematic study of parthenogenesis has already shed much light on general physiology, and progress will be more certain if all of these problems be kept before the mind of the investigator.

[7] *Science*, 1914, Vol. 40, p. 214.

THE OHIO PLAN FOR THE STUDY OF DELINQUENCY

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BY the careful study of the problems of human heredity in the last few years, eugenic workers have brought about a more general appreciation of the tremendous burden and waste brought about by the propagation of misfits. It is generally accepted that the principles of breeding, which hold for Guernsey cattle and navel oranges, hold also for human beings—that social misfits reproduce their defects quite as certainly as do long-haired guinea-pigs and corn grains, rich in starch content, reproduce their respective qualities. Mendel's Law is valid for all living forms. Furthermore, high-grade defectives are very prolific. Restraints, which affect the numbers of children borne by normal mothers, have no effect upon the amount of progeny of the feeble-minded, so they tend to reproduce much faster than the normal persons around them. It is therefore self-evident that society must impose artificial restraints, for its own safeguarding.

1. The first suggestion, which occurs to every one, is to segregate the misfit and thus prevent propagation. With the estimates of the numbers of defectives, it is quite impossible to provide asylums, schools and custodial farms for all defectives. Such institutions as are provided by states and private munificence are everywhere overcrowded and holding long waiting lists, while normal children in the public schools are hindered in their education by the presence in their classes of feeble-minded children. It is much too great a burden for society to undertake the lifelong segregation of all the feeble-minded. Furthermore, it is not an intelligent procedure, until we are better informed as to different sorts of defect, and their respective viabilities in the stocks.

2. Again, sterilization has been proposed as a panacea for this social ill—the threatened enormous increase of the feeble-minded. But this is by no means a solution of the problem. Sterilization would certainly stop the breeding of the sterilized, but the consequences of known immunity from conception through salpingectomy of the female or vasectomy of the male, would lead to much increase of immorality and spread of venereal diseases. Such operations do not remove sex feelings for a considerable period of time.

Twelve states have passed sterilization acts. Seven of these specifically provided for the sterilization of the mentally defective; three others, of inmates of state hospitals, reformatories and prisons; and two, of habitual criminals and persons guilty of abuse of girls under ten

years of age. The law has been declared unconstitutional in one state. Public opinion is by no means ready for such treatment, even of the confirmed criminal or very dangerous imbecile. And it is quite out of the question to get sterilization enforced in cases of high-grade defectives. These are often attractive, and do not seem to be defective to casual observers. They are, however, most fertile sources of burdens to the state.

3. For delinquent minors, most states have provided reform schools and homes. At these schools, industrial education is emphasized, and this, with able field officers, is depended upon for turning these social misfits into useful law-abiding citizens. A very fine service has been rendered by these institutions. Many successes decorate their annals. It is, however, recognized that the institutionalizing of many boys and girls is a positive damage to their characters. Some acquire many anti-social habits and traits therein.

Most important in regard to the organization and work of these institutions is the question of mental deficiency in the delinquent. The high-grade defective has not been commonly recognized, and we now know that many such are and have been in these reform schools, and the officers of such institutions have entertained hopes of eliminating further delinquencies through education. But the education of defectives is a very special process, and it is well known that no education can overcome the defect in the native endowment of the individual.[1]

If, therefore, the delinquency is directly chargeable to the defect, the optimism and the procedure alike are ill founded. In so far, the state is misdirecting her energies, and wasting her funds. It is wise, therefore, to ascertain in the case of each delinquent, whether or not he is educable, and if so, in what direction and how far. Of course, practical psychology is far from giving us specific answers to these questions. But, we can ascertain whether or not there is definite feeble-mindedness in any given case, and the search for better answers to the above questions is a line of activity wherein research should save the state both money and citizens. The two classes, defective delinquents and delinquents in which no defect can be found, require different treatment. It is unfair to both to keep them together in one institution.

4. Another and newer agency dealing with juvenile delinquency is the Juvenile Court. The first of these was provided for in Chicago in 1899. There can be no doubt as to the value of this court with its probation system and social workers. They have saved many a child from a life of crime. It is a much saner system than its predecessor for supplying intelligence and authority to the management of children with whom the home is unable to cope. The older plan was that of the

[1] For statistics concerning extent of feeble-mindedness among delinquents, see H. H. Goddard, "Feeble-Mindedness," 1914, p. 9.

regular police and common pleas courts. It is, however, most important for these Juvenile Court officers to know whether or not the so-called badness of the child is due to defect, and in what direction and to what extent he may be educated for useful citizenship.

The question of defect, therefore, is looming large in the whole field of delinquency. In order to economize effort at reform, and at the same time make the greatest social salvage possible from these threatening wrecks of lives, we must know what is reformable. Clear defectives can not be trained into responsible citizens. They must have the education, which will bring them the greatest amount of happiness and make them as nearly self-supporting as possible, but they are not to be expected to become self-directive. They must be directed, and they must be prevented from propagating their defects.

There are cases of delinquency in which experts will agree that there is deficiency of the moral or social organization, while no definite defect in intelligence can be made out. There is defect in the organization of the self, and in the power of self-control. This defect is inherent also, and can not be remedied by education. This class of cases, some are classifying with defective delinquents. They are close to what have been called psychopathic personalities and cases of moral insanity. The defect is, of course, more difficult to define than a definite intelligence defect. It is also less certain that it is congenital and nonrecoverable. For these reasons, attempts to reform, through most skillfully guided education, should be made. This is the class for our reform schools. No clear defectives should be sent thither.

There are other delinquents coming to probation officers, and some to reform schools, who are in no sense defective. They are purely the product of mismanagement or lack of management. They are delinquent because society has not socialized them, and not through any lack of capacity to become socialized. These should never be sent to institutions. They need good home environments.

The large economic problem of delinquency has thus defined itself. No one can doubt the economic importance of making investigations into the causes of delinquency in each case, and the application of psychology and sociology to whatever extent possible in every case. Many cases are clear-cut. The relatively untrained person knows this one to be feeble-minded, and that one to be purely the product of a bad environment. But the doubtful group, a large one, demands expert talent for investigation.

Another field of research, and closely akin, is immediately suggested to the alert student of these problems. It is not only the scientific handling of the individual delinquent, so as to make the most social salvage of him, and save society the expense of supporting him, if possible. It is much more important to stop this social waste—this

production of misfits, at its sources. We need a social survey of large bodies of our population, so as to map out the tainted stocks. Such a thoroughgoing study of kakogenics in the territory of a given state would enable that state to develop principles to guide in the practise of breeding out these bad strains. All agree they are just as dangerous and expensive as smallpox, typhoid or tuberculosis, and that we should proceed by equally radical measures for the extermination of such strains as are used to rid communities of these diseases.

This view of the problems involved in delinquency, through the insight and persistency of Dr. E. J. Emerick, superintendent of the Ohio Institution for Feeble-Minded, and of Dr. A. F. Shepard, member of the Ohio Board of Administration, secured legislation during the winter of 1912–1913, providing for the establishment of a Bureau of Juvenile Research, July 1, 1914. The provisions of the statute are as follows:

Section 1841—1.—All minors, who in the judgment of the juvenile court require state institutional care and guardianship, shall be wards of the state and shall be committed to the care and custody of the "The Ohio Board of Administration," which board thereupon becomes vested with the sole and exclusive guardianship of such minors.

Section 1841—2.—"The Ohio Board of Administration" shall provide and maintain a "Bureau of Juvenile Research" and shall employ competent persons to have charge of such bureau and to conduct investigations.

Section 1841—3.—"The Ohio Board of Administration" may assign the children committed to its guardianship to the "Bureau of Juvenile Research" for the purpose of mental, physical and other examination, inquiry or treatment for such period of time as such board may deem necessary. Such board may cause any minor in its custody to be removed thereto for observation and a complete report of every such observation shall be made in writing, and shall include a record of observation, treatment, medical history, and a recommendation for future treatment, custody, and maintainence. "The Ohio Board of Administration" or its duly authorized representatives shall then assign the child to a suitable state institution or place it in a family under such rules and regulations as may be adopted.

Section 1841—4.—Any minor having been committed to any state institution may be transferred by such "The Ohio Board of Administration," to any other state institution, whenever it shall appear that such minor by reason of its delinquency, neglect, insanity, dependency, epilepsy, feeble-mindedness, or crippled condition or deformity, ought to be in another institution. Such board before making transfer shall make a minute of the order for such transfer and the reason therefore, upon its record, and shall send a certified copy at least seven days prior to such transfer, to the person shown by its records to have had the care or custody of such minor immediately prior to its commitment, provided that, except as otherwise provided by law, no person shall be transferred from a benevolent to a penal instution.

Section 1841—5.—"The Ohio Board of Administration" may receive any minor for observation from any public institution, other than a state institution, or from any private charitable institution, or person having legal custody thereof, upon such terms as such board may deem proper.

Section 1841—6.—Each county shall bear all the expenses incident to the transportation of each child from such county to such "Bureau of Juvenile Research," together with such fees and costs as are allowed by law in similar cases, which fees, costs and expenses shall be paid from the county treasury upon itemized vouchers, certified to by the judge of the juvenile court.

Section 1841—7.—The provisions of this act shall become valid on and after the first day of July, 1914.

It is thus seen that Ohio plans through the "Bureau of Juvenile Research," to study the problems of delinquency from the points of view of the best technology afforded by sociology, psychology and the biologic sciences. The law contemplates in this bureau a great laboratory for the study of vital phenomena—of sociologic material in the widest sense. The records of observations and examinations upon children, in the first place, will be expected to enable the authorities to deal with each child much more intelligently than they have been able to do heretofore. The reasonable expectations in regard to education will be set forth clearly in each case. Futile efforts to overcome native defect will be avoided. Doubtful cases of defective delinquents will be given experimental treatment in reform schools, till they are proved to be unimprovable or are improved. The non-defective delinquents will be saved from institutionalization, which will result in great economy both to the individual and to society.

There will result a new conception of the work of our reform schools, and also a new conception of the work of its field officers. The reform school is not to be expected to overcome native defect, but it is to be an experiment station trying out doubtful cases, ascertaining what retardations may be overcome. The field officer is to be a very highly trained practical sociologist, skilled in all the arts of guiding into proper lines the forces of socialization. His is to be the art of making personalities.

The lines of work undertaken in such technological studies are sure to result in new conceptions and divisions of feeble-mindedness. They are also likely to bring new visions as to the relations of intelligence to the will and emotions—the relations of knowledge to the springs of action and conduct.

It is also reasonable to expect that the clinic with its constantly flowing stream of delinquents, and the archives resulting from exhaustive physical, mental and social examinations made in the clinic and in the field will become a great museum for research into the kakogenics of the state. Society is not ready to demand eugenic marriages, but the accumulation of such material as this Bureau of Juvenile Research is making constitutes a most intelligent procedure to prepare us to control and to eliminate the propagation of the unfit. These investigations will also make contributions to pure science in psychology, sociology and biology.

SCIENCE AND HISTORY

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THE question has been a good deal discussed whether history is a science or an art. Those who deny to it a place among the sciences proceed on the assumption that science deals only with facts, with uncontrovertible truths, and as history is for the most part founded on the preponderance of probabilities, it should not be ranked as a science. It is not possible to frame a definition of science sufficiently comprehensive to embrace all subjects that may be investigated by man. Only a single branch of science deals with incontrovertible truths, that is mathematics, while the subject matter of all others is constituted of data and not of facts. Science is founded upon method rather than upon results. All the sciences that deal with forces which may be more or less modified by acts dependent upon the human will, such as economics, politics, ethics, and others of the same class, can never attain positive results. Besides, some of the sciences are constituted of forces that are latent and more or less inscrutable so that there is no possibility of predicting when they will become active. Comte placed geology among the histories. It is the discovery of the changes that have taken place in the composition and recomposition of the globe. While there is substantial agreement among experts as to the order in which these changes took place, there are many minor points upon which there is more or less divergence of opinion. When we endeavor to set forth the order in which events took place we produce history, even though the artistic element be entirely lacking. History, as the term is usually understood, is the interpretation, from written records, of the psychic forces as manifested in acts and institutions. By *written* we are, however, to understand all the devices which men have employed for the purpose of preserving the memory of their deeds to future generations. William James defined history "as the observation of a series of changes of conditions that never exactly repeat themselves and that ever tend toward further and unfathomable changes."

According to this definition everything in the universe that is capable of being intellectually apprehended and is not static may be dealt with historically. The discovery and investigation of the memorials that man has unintentionally left of himself are usually classed as prehistory, and include paleontology, anthropology and some other sciences.

The term *history* is used interchangeably in one of two senses, although they differ widely. Can there be a history where there is no

record, or only a very incomplete one? If we say, the French character is the product of French history, we mean one thing; if we say, M. Martin wrote a French history or a history of the French, we mean something quite different. This distinction is rarely observed with care.

All knowledge, every fact as distinguished from opinion or belief, may be classed under the head of science; at any rate, it is difficult to distinguish between them. There is a great deal of knowledge not intellectually apprehended that is the result of experience or of instinct. We are wont to employ the latter term to designate a capacity which we can not further analyze. Most quadrupeds when thrown into deep water swim as readily the first time as the twentieth, while man can not swim until he has learned. We know that quadrupeds can swim, but it is a question whether they know it. Is it proper to apply the term *knowledge* to what is known without having been learned? Most men as well as other animals learn by experience; the latter only to a limited extent however. The most important discovery ever made by man was the use of fire. How he made it we do not know. The Greek myth of Prometheus, who is reputed to have stolen it from heaven, points to a celestial origin, that is to a stroke of lightning. How highly fire was prized in ancient times is demonstrated by the veneration accorded to the Vestal virgins. They represented the last remnant of paganism to give way before the advance of christianity. Herodotus relates that the sole surviver of the Lacedæmonians at the battle of Thermopylæ was so disgraced that "no Spartan would give him a light to kindle his fire." In pioneer times the housewife was usually careful to keep the fire on the hearth from going out in the summer when it was not needed for warmth. In this respect civilized people usually exhibit less ingenuity than savages. The practical use that could be made of fire was without doubt the most important discovery made by prehistoric man; it is probable that his rise from the bestial stage began with it.

Buckle believed history to be the most popular branch of knowledge and the one upon which most had been written. If his opinion is correct it is due to the circumstance that it is hardly possible to deal with any subject without viewing it to some extent historically. But he also considered the most celebrated historians inferior to the most successful cultivators of physical science. The comparison is unfair because the subject matter is widely disparate. The cultivator of a physical science works with his materials directly; the historian indirectly. The former is a good deal in the position of the magistrate who, when trying a case, has his witnesses before him. He can examine and cross-examine until he has ascertained the truth as nearly as possible. The latter is like the same official who has to rely upon affidavits. He can not go behind the returns, or if he does, he has to depend upon surmises and prob-

abilities. Although Buckle wrote a history of civilization and frequently uses the term, as also science and history, I do not find that he defines any of them. He undertook to write a history of human progress that should be as trustworthy as a work on natural or physical science, because he thought it possible to discover and to formulate its laws as clearly as those of the material universe. Neither does M. Guizot define civilization, although he devotes many pages of his work to explaining what he means by the term. M. Rambauld in his recent history of French civilization admits that, notwithstanding the vast amount of work that has been done in the collection of materials, there are still many points to be cleared up. After telling his readers what sort of a history he proposes to write, he sums up by saying: "In a word, how our ancestors lived and by what labors they prepared the better life that we now enjoy." This sort of history approaches most nearly to a physical science because it deals with such general facts that they can be confirmed by a great deal of testimony. We can usually tell how a people who come within the historic period lived, what were their customs and their religion, what was their social and political organization, even when we are constrained to accept with much reservation the reputed deeds of individuals.

The term "science" has of late fallen into almost as great disrepute as the other much-abused word "professor." Both have shared the fate of the man who once upon a time went down to Jericho. We hear of a science of carpentry, a science of journalism, a science of athletics, a science of horse-shoeing, and the like almost without end, every one of which is presided over by its appropriate professor, or by several of them. If we could have a science of humbug, a science of dulness, a science of false pretense, each properly manned or womaned, our gullible public would probably ere long be wiser than it is now. When the English language contained only forty or fifty thousand words, every one had a fairly definite meaning which all intelligent persons understood. Now when it is reputed to include about ten times as many, each one is given the significance that the ignorance or the heedlessness of the user chooses to assign to it. For as Mephistopheles said to the student:

> And just where fails the comprehension,
> A word steps promptly in as deputy.

What doth it profit a man to enter upon the laborious and endless task of seeking for facts when words will serve many more purposes and can be picked up anywhere and everywhere?

History being the written record of events arranged with reference to their relation to each other as cause and effect in the nature of the case is preceded by chronicles. The peoples who inhabited all that part of the world known as the "Ancient East" hardly got beyond this stage. We have characteristic specimens in the Old Testament. In many,

perhaps in all, of the Greek cities, chroniclers were also at work. Wherever language has been reduced to writing men have appeared who kept records. Sometimes they were public officials, sometimes private persons who wrote for reasons which they could probably not themselves have explained. It is known that Herodotus used materials collected by municipal chroniclers when compiling his historical work. He tells the reader that he published his researches in the hope of preserving from decay "the remembrance of what men have done and of preventing the great and wonderful actions of the Greeks and Barbarians from losing their due meed of glory." When he adds that he wants "to put on record what were the grounds of their feud," he enters upon the field of philosophical if not of scientific history.

Except in the quantity of materials collected the modern "local paper" may be regarded as the successor of the old-time chronicles. Its object is to record events from day to day, without taking into account their connection with each other, even when there is such connection. All local newspapers are unreliable except in so far as they publish proceedings of municipal councils, of courts and of other public bodies. None of them print anything that would put a "leading citizen" in a bad light. We may be sure that most of the records of the olden time, except in rare cases, partook of this character. It is evident that any person endowed with ordinary common sense who has a fair education can write a history. All he needs is materials upon which to base his conclusions. But a history written with no other object in view than to set forth facts nobody would read except from a sense of duty or as an act of penance. The work of the historian worthy of the name requires not only judgment in the scrutinizing of evidence, but likewise in the sifting and arrangement of materials and the final form that is given to the narrative. It is probable that in the matter of artistic form the models set up by the Greeks and Romans will never be surpassed. But the range of their discussion is either very narrow, or their statements full of errors. They are chiefly concerned with wars or with those things that pertain to war; they fail to tell us much that we should like to know, and of which they could give us trustworthy information because it came under their immediate observation. They omitted what they considered of no importance; they lacked the point of view of the scientist, to whom nothing that exists is unimportant. It is probable that Professor Freeman formulated his definition of history as "past politics" from a study of the works of the ancients. This definition is now regarded as grossly inadequate because the reading public has come to realize more and more fully that in states which claim to be civilized only a small part of the people are directly engaged in war or politics. Except in rare instances the proportion has never been much larger. Nor does any man now agree with Xenophon that the only

occupations worthy of a gentleman are war and politics. But even Voltaire believed that a state of war was more conformable to the nature of man than one of peace.

The belief that a history should appeal more to the feelings of the reader than to his judgment is now held by few persons. As the drama is the most moving of literary compositions history should be dramatic, that is, it should be a work of art, not a collection of documents. Voltaire maintained that a history like a tragedy should have an exposition, a development of the action, and a catastrophe. He maintained that the historian should not only have an extensive acquaintance with the affairs of the world, but should also be endowed with the capacity for dramatic representation. He calls the citation of documents foolishness, and appeals to the example of the ancients as proof of his contention. Documents he considered nothing more than the scaffolding which is taken away when a structure is completed. Frederic Schiller, who was a skilful dramatist and a writer of the first rank, composed histories without knowing much history. Moreover, he did not pretend to know much. He once wrote to a friend that history was a sort of storehouse for his imagination, the contents of which had to submit to whatever use he wished to make of them, and that he would always be a poor authority for any future writer who should be so unfortunate as to turn to him. The belief that the value of a history depends more upon the style in which it is written than upon the matter which it contains prevailed almost universally until comparatively recent times. Oliver Goldsmith wrote a "History of the Earth and Animated Nature," the title of which he probably borrowed along with a great deal of the matter from Buffon's "Histoire Naturelle." Albeit, more than one of his readers has ventured to doubt whether he could have told a duck from a goose. Yet he produced an interesting work, as I can testify from the impression it made upon me when I first (and last) read it many years ago. Both the Irishman and the Frenchman looked at the world through the medium of their imagination, and consequently saw many things that had no objective existence. In 1877 Professor Du Bois-Reymond delivered an address in Cologne in which he endeavored to prove that the history of mankind is virtually the history of the natural sciences. Although he defended his position with much skill and eloquence, he probably carried conviction to the minds of but few of his hearers and readers. Others have maintained that history is embodied in the efforts of men to invent better tools. It is not easy to see how, viewed from either of these positions, there could be any history for more than a thousand years beginning with the Christian era. There is a great deal of movement and at times a great deal of intellectual activity, but the result was fruitless. In the penal system of former days the treadmill was a common mode of punishment. The exercise

doubtless strengthened the arms and legs of the criminal, but it was without profit to anybody. After the writings of Aristotle became known in western Europe they were accepted as the final word upon every subject on which the Stagirite had expressed himself. Yet he would have been the first man to protest against such a misuse of his books. Far more intellectual ingenuity was expended in trying to prove that they were true than in investigating to what extent they were true. If there is a subject that intimately concerns every man, woman and child, it is the healing art. And it has always been the same. Yet so thoroughly convinced were the minds of the medical fraternity that Galen had spoken the last word upon their profession, that until the beginning of the modern era he had the whole field to himself. When John Locke was in Montpellier he attended the ceremony of conferring the degree of doctor of medicine upon a candidate. Part of it consisted in an address by the head of the faculty which in this case was almost wholly taken up with a diatribe against Harvey's theory of the circulation of the blood.

The history of medicine illustrates in a striking way the tendency of the human mind to stagnate and dogmatize, and demonstrates how an art eventually becomes impregnated with the scientific spirit. The infancy of medical science falls in the middle of the seventeenth century; it is therefore not three hundred years old. In the Iliad physicians are held in great esteem by the Greeks. Herodotus tells us that the medical art was highly specialized in ancient Egypt and that there were physicians for almost every part of the body. Embalmers were also classed among physicians, for we are told in Genesis that Joseph commanded the physicians to embalm the body of his father. That there were practising physicians in Palestine at an early period is evident from a few passages in the Old Testament. When we reflect that the ancient Greeks were almost continually at war either with barbarians or among themselves, it seems incredible that their books tell us almost nothing about the care of the sick and wounded in their armies. Xenophon relates that once during the retreat of the Ten Thousand, after a particularly severe conflict with the enemy, the officers found it necessary to appoint eight physicians because there were many wounded. If he had said "additional" we should suppose that the number of those whose duty it was to attend to the disabled was insufficient. The passage clearly conveys the meaning that there had been no previous provision for an organization corresponding to the modern ambulance corps. It is doubtful if the ancient Greek language contains a word corresponding to our "hospital." Hippocrates did not dogmatize, for the reason that he was one of the world's really great men. But some of his pupils founded the Dogmatic school; and while they made a few discoveries, their system was vitiated by philosophical theorems and

subtleties. For nearly two centuries they had the field to themselves, when the inevitable reaction came and the Empirical school arose. This was in some measure a return to first principles. Some centuries later appeared Themison of Laodicea, who was the most conspicuous person among the disciples of the Methodical school. He endeavored to trace all diseases to a few types and to find a cure for each type. Here was evidently something more than a mere glimpse of the real state of the case. His contemporary, Athenæus of Cilicia, founded the Pneumatists, whose adherents assumed the existence of an air-like substance in the human body, to which its condition both in health and disease was due. Agatinus of Sparta, the father of the Eclectic school, came a little later. The circle of medical theory was now complete. Galen, at a subsequent period, compiled a sort of medical encyclopedia, and although he was both a careful observer and a profound thinker he could not free himself entirely from the prejudices of his age. About a thousand years later several physicians of note appeared among the Saracens and the Jews; but their skill was due rather to sanity of judgment than to knowledge of the healing art. All the sciences and most of the arts have every now and then found themselves in a blind-alley where no further progress was possible until some hitherto unknown way out had been discovered. Medical knowledge and skill had probably exploited their opportunities to the utmost seventeen or eighteen centuries ago. There was no advance possible until the microscope had reached a high degree of excellence. The progress of chemistry had also an important bearing on the healing art. An air-ship sufficiently powerful to carry a man has been desiderated ever since Dædalus made his famous flight from Crete to Italy. Albeit, there seemed to be no possibility of repeating the performance until either the original secret had been rediscovered or some fuel lighter than any known a generation ago. Michael Faraday declared that "there is not a law under which any part of the universe is governed that does not come into play in the phenomena of the chemical history of a candle."

The history of human thought as distinguished from the history of human acts is at bottom a quest for the fundamental principles by which the cosmos is governed. "Philosophy," says Schwegler, "deals with the *totality* of experience under the form of an *organic system* in harmony with the laws of thought." But as the totality of experience is not the same to-day that it was yesterday, nor will it be the same to-morrow that it is to-day, we are always getting a little nearer to a goal which can never be reached. The history of philosophy is for the most part the history of efforts to systematize knowledge from the observation of a comparatively small number of facts. The mistakes into which such a method leads is now so fully recognized by historians of human actions that they refuse to formulate a philosophy of history. They assure us

that it is as unscientific, and therefore as illusory, to seek a plan in the course of events as it would be to seek a plan in the constitution of the cosmos. Some of their maxims are:

> Tell us nothing except what the evidence before you warrants and tell us everything for which you find evidence, so far as the space at your command will permit. No man has a right to ask for himself or for his friends immunity at the bar of history. The historian is a judge, not an advocate.

There can be no doubt that the gradual change that has come over the attitude of the more intelligent public opinion toward the past is due to the progress of physical science. The man who is in advance of his age usually has to pay the penalty for his rashness. How many men beginning with Anaxagoras have suffered banishment, imprisonment and torture for daring to know more than those who had his fate in their hands. It is a melancholy tale that has been repeated over and over again. Albeit, in the conflict between conservatism and radicalism the latter has always won in the end. To it has come the reward that always comes to the undismayed searcher for truth.

The fundamental principle of art is deception. A work of art is either an illusion or a delusion. It is never an exact reproduction of nature, of facts. A portrait which accurately represents an original is not artistic. A painting, a photograph, an engraving is such a disposition of white upon black or of colors as to produce the illusion of relief. An accurate drawing can not be made of a work of art. Neither can work on chemistry, or on physics or on biology or on mathematics be made artistic. The same is true, in a large measure, of historical writings. A faithful chronicle is not a history even when the connection between cause and effect is clearly set forth. It comes too near the truth, it approaches too close to science to be interesting to the great majority of readers. Hence the more artistically a history is constructed, the more popular it is likely to become, and likewise the more unreliable. The purpose of the artist is to produce pleasure by deceiving the spectator or the reader. Every historian endeavors to make his work interesting, readable. No scientist feels such a prompting. The distinction that is now usually made between the terms science, knowledge and learning is not of long standing. Bacon's "Advancement of Learning" is merely a translation of "De Augmentis Scientiarum." Science, as now generally interpreted, means the accumulation of facts relating to man and the universe that have been discovered because they were sought. *Learning* is used to designate data that have been stored up in the memory without examination of their accordance with facts. A man may be very learned, yet be in possession of a very small quantity of real information. *Knowledge* is used to designate those facts that men have come into possession of by experience and observation. Rome grew great and eventually made itself master of the known world with-

out having produced a single scientist. Pliny is the only Roman who has the slightest claim to this designation. Yet his "Natural History" is such a vast collection of absurdities that one wonders how an avowed atheist could think it worth while to record them. He cites nearly five hundred writers as his authorities, and it is known that he was an indefatigable reader. But he had time neither to think nor to observe. He was conscientious in the performance of every duty incumbent upon him, and thought he was doing posterity a great service in the compilation of his work. He was skeptical in everything that came under his own observation, and credulous of the testimony of others. He was a predecessor of Faust who at one period of his career congratulated himself that he knew more than everybody else, was haunted by neither doubts nor scruples, feared neither hell nor the devil, hence had given himself over to magic. It is unscientific to call anything that happens or is, "strange"; yet one is often tempted to apply the epithet to that characteristic of man that makes him averse to the truth when it is disagreeable or conflicts with preconceived opinions. Opinions and beliefs can not change the most insignificant fact. It is only the truth whether in science or history that abides.

THE ANTECEDENTS OF THE STUDY OF CHARACTER AND TEMPERAMENT

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THE strong practical interest in the sources and varieties of human powers and their proper direction and training, may be utilized in behalf of the retrospective aspects of the subject. The antecedents of "character and temperament" concern in the main the story of false and ambitious leads and venturesome solutions of the sources of human nature. However completely discredited, they belong to the irrevocable stages of our intellectual heritage, and show how uncertain has been the occupation of the psychological realm. The historical connection between the antecedents and present-day views is irregular; the succession of opinion is largely by replacement and outgrowth. None the less the points of connection are frequent with the body of knowledge which we draw upon so readily for the satisfaction of our systematized and rationalized inquiries.

The popular interest in human nature is itself an expression thereof. Actions are largely regulated as well as interpreted by psychological considerations; and these turn attention to the nature of the mind. The feeling of strong impulse, the sense of conflict between emotions as also between desire and sanctioned conduct, the search for motives, as well as the shrewdness of the battle of wits, and the reading of another's intentions shape psychological insight. "Know thyself" is an ancient precept—at once a moral injunction and an invitation to psychological study. The early contributions to the field to be surveyed came from the learning aptly called "the humanities," and reflected the insight of experience, directed by an unschooled but worldly-wise analytical temper. Quite as science is glorified common sense, so is literature elevated common sentiment; either may fail to rise above a suggestive type of opinion or pleasing conjecture. The delineation of character springs from the impressionistic attitude towards the products of nature and the vicissitudes of fortune. It is animated by a fundamental interest in one's kind. It trains men to be practitioners, empirics in large measure, in the arts of human intercourse, and tends to establish man as the proper study of mankind.

The distinctive service of Greek thought was to launch the permanently engaging intellectual problems; to this rule the problem of character is no exception. It presents the two tendencies—the impressionistic and the analytic—in characteristic form. Theophrastus (370–288 B.C.) is the prototype of the impressionistic delineators, yet is not

without an analytic strain. He sets forth his intentions thus: That although all Greece is of one

> clime and temperature of air, and Grecians in general bred and trained up after one fashion, should notwithstanding, in manners and behavior be so different and unlike. I therefore, O Polycles, having a long time observed the divers dispositions of men, having now lived ninety-nine(?) years, having conversed with all sorts of natures good and bad, and comparing them together: I took it my part to set down in this discourse their several fashions and manners of life. For I am of the opinion, my Polycles, that our children will prove the honester and better citizens, if we shall leave them good precedents of imitation: that of good children they may prove better men.

The "Characters" of Theophrastus form a group of sketches of human foibles, holding the mirror up to nature, comprising the dissembler, the flatterer, the gossip, the toady, the fop, the miser, the superstitious, the mistrusting, the querulous, the bully, the coward, the stubborn, the pompous, the boor and the bore, the malaprop of either sex, the well-intentioned fool and the public-disregarding autocrat. This gallery of mental and moral shortcomings served as a model for distant ages. A group of delineations of character appeared in England in the seventeenth century; and the model was still suggestive when George Eliot chose the title for her "Impressions of Theophrastus Such." The modern delineations emphasize circumstance, the vocations and social stations, reflect a more varied, a more specialized, and a more complicated world. The "idle gallant," the "meer dull physician," the "upstart country knight," the "pot-poet," the "plodding student," the "down-right scholar," as well as the "self-conceited man," the "vulgar-spirited man," the "too idly reserved man," and men of other dispositions are subjected to keen strictures in the "Microcosmography, or a Piece of the World Discovered in Essays and Characters" by John Earle (1628). Such portraitures of human peculiarities, gauged by their moral or social desirability as examples to be followed or avoided, form an attractive compendium for the interpretation of men and their ways. Their consideration, ranging from gossip to philosophy, supplies the common touch of nature that makes the world of every time and clime akin, and presents graphically for our psychological contemplation the outward issues of disposition as shaped by opportunity and circumstance.

This vein of character-mining failed to yield the native ore of disposition. The more fundamental problem was early recognized in the venerable doctrine of the temperaments as the alleged determinants of the original yet distinctive natures of men, and in the general notion that outward uncontrollable forces, such as climate, and directive ones, such as breeding and training, were responsible for the types of individuals and races—as duly indicated by Theophrastus. The doctrines of the school of Hippocrates (fifth century B.C.) formulated the Greek point of view. Its philosophical procedure followed that of Em-

pedocles in the search for elements and in the explanation of manifold appearance as their variable combination. The elements of creation were regarded as fourfold: Air, fire, earth and water. These are distinctive by virtue of elemental qualities: namely, dry and moist, hot and cold, heavy and light, which by combination yield the qualities of the elements: fire as hot, dry and light; water as cold, moist and heavy, and so on. The fourfold elements of the body are the *humors* or fluids: the blood, the (yellow) bile, the phlegm, and the black bile. (3) Subjected to the play of analogy and correspondence in the speculative manner then employed, *blood* becomes related to *air*, has the quality of being *warm* and *moist;* the season which it typifies is *Spring*, and its temperament is the *sanguine*. Its direct opposite is *earth*, which is *cold* and *dry*, finds its bodily correspondent in the *black bile* and its season in the *Fall* of the year; its temperament is the *melancholic*. Fire as *warm* and *dry* has special relations to *Summer*, is represented in the body by the *yellow bile*, and produces the fiery or *choleric* temperament; while water as *cold* and *moist* is allied to the *phlegm*, to the sluggish season of *Winter*, and to the languid temperament which we still, in deference to Hippocrates, call *phlegmatic*.

These views were held as much more than speculative possibilities; they were practically applied. Diseases were regarded as defects in the composition of the humors, to be counteracted by appropriate applications of heat and cold, or of dry and moist, to restore a favorable equilibrium. Winter was held to be the dangerous season for a temperament lacking in fire; the body must not be too full of humors nor yet be too dry and sapless. The several ages of man, from childhood to senility, reflected the natural sequence of dominance of the several humors.

The doctrine of temperaments is historically important quite beyond any illumination which it affords. It is obvious that the philosophers of the school of Hippocrates had no means of ascertaining that cheerfulness was resident in the blood, laziness in the phlegm, testiness in the yellow bile, and low-spiritedness in the black bile; nor that any such fundamental vital basis was afforded by the "humors" thus distinguished. Their habits of mind inclined them to such an opinion; and their sense of plausibility was gratified (where we see only far-fetched and irrelevant analogy) by observing the hot moist fluidity of blood and the damp cold sluggishness of phlegm. The originators of the doctrine of temperaments were empirical psychologists, who observed that differences of mental disposition, like cheerfulness and testiness, were common and conspicuous traits of men. They were also medical practitioners with a fair knowledge of the body and its ills, and recognized that mental dispositions were intimately related to bodily condition. Their philosophical temper found satisfaction in connecting these two varieties of information through the doctrine of the temperaments.

This doctrine does not stand alone as such an attempt. The "spirit" theory of disease has a like basis and purpose; it reaches from primitive medicine to Christian exorcism and beyond. The reference of epilepsy or other mental invasion to a foreign and malignant spirit is not unrelated to the notion of animal spirits coursing through the body and finding a local habitation in the ventricles—literally, breathing-spaces—of the brain. Again, the doctrine of signatures, in accordance with which red flowers were considered efficacious in the treatment of blood diseases and yellow ones in the treatment of jaundice, or "heart's-ease" was prescribed for heart trouble, and walnuts for mental disorders (by virtue of the resemblance of their outer shell to the skull and of their convoluted kernels to the brain) illustrate the force of native analogy in cruder practises.

When notions of this order, instead of being carried along as the folk-lore products of primitive thought, assume a systematic form, they become more fantastic in the analogies employed as well as more remote from a corrective common sense. Astrology is the most ambitious of such efforts in both design and scope of application. The three persistent motives in this world-wide and world-old expression—a composite of primitive culture, superstitious survivals, and pseudo-scientific elaboration—seem to be the cure of disease, the reading of character, the fore-knowledge of the future and in all, the control of fate. The motives combine. Astrology aims to determine the character as well as the careers of men, to predict their liability to disease and its issues, and to prescribe the set of disposition—making one of jovial temperament if the hour of birth showed favorable relations to Jupiter, or gloomy (saturnine) if Saturn ruled the critical moment. These and related notions and systems form a vast background of belief, continuously influencing the views of character and its sources. Whether the causes or the signs of dispositions were regarded as resident in the fluids of the body, or in the stars and planets, or in the detailed contours of the features of the face and head—as in the later physiognomy, itself a revival of classic and popular lore—or with more modern but no less fanciful elaboration, in the "bumps" of phrenology, or again in the creases of the hand upon which palmistry specializes, there appears in all a common practical motive in the control of fate through insight or revelation, and a common quasi-logical attempt to establish its basis by reading the secret of its conditioning—the insignia of its dominion. The logic of the procedure, as judged by our standards, is of the feeblest, but these standards are the issue of many generations of experience, each critically testing the conclusions, revising and enlarging the data, of its predecessors. The stress of practise, we must bear in mind, is insistent. Men will apply what knowledge they have; they can not await its perfection. Ideals and systems support the intercourse with reality, but they also express the

progress attained in reading its meaning; the ideal "has always to grow in the real, and often to seek out its bed and board there in a very sorry way" (Carlyle).

The ancient and honorable place of the doctrine of the temperaments in the evolution of psychological knowledge warrants its further consideration. Most influential were the contributions of Galen (A.D. 130–200), who developed the views of Hippocrates and whose authority dominated the medical world for centuries. The doctrine became a classical heritage through its incorporation in the Galenic system of medicine. Its survival in the transfer of Greco-Roman science and tradition across the desert of unprogressive ages, with their uncertain and irregular caravans of learning, was due largely to its association with the "humoral" theory of disease. This remained a central as well as a controversial issue in medieval and renaissance medicine, and was effectively retired only by the complete transformation of physiological conceptions inaugurated by Harvey's discovery of the circulation of the blood (1628). Along with this decisive reform in knowledge and method there was established the clinical temper of the practise of medicine, which was as largely set by Sydenham (1624–1689), as were the experimental standards by Harvey, as similarly the anatomical prerequisite had been supplied by Vesalius (1514–1564). Cumulatively these advances served to cast off the spell of Galen and to install verification and observation in place of authority. As a herald of the new learning, the philosopher John Locke, a friend of Sydenham's, wrote:

> You can not imagine how a little observation, carefully made by a man not tied up to the four humors (Galen) or salt, sulphur, and mercury (Paracelsus), or to acid and alkali (Sylvius and Willis) which has of late prevailed, will carry a man in the curing of diseases, though very stubborn and dangerous; and that with very little and common things, and almost no medicine at all.

These considerations show to what extent practises kept alive systems precariously supported by principles. Symptoms such as fevers and chills, parching and perspiration, substantiated the hot and cold, the dry and moist as clinical realities. Remedies were prescribed to counteract them, diets were arranged according to degree of dryness and moisture. Even when the classic doctrines were discarded, they were replaced by others developed in like manner.[1]

[1] Medical theories and practise were reflected in popular lore. To recall the spirit of the ministrations it is sufficient to cite the venerable Chaucerian diagnosis made by Pertelote of Chanticlere's affrighting dream. This was ascribed to "the grete superfluitie Of your reede colera, parde, Which causeth folk to dremen in her dremes Of arwes, and of fyre with reede leemes, Right as the humour of malencolie Causeth ful many a man, in sleep, to crye, For fere of beres, or of boles blake, Or elles blake develes woln him take. Of othere humours couthe I telle also, That wirken many a man in slep ful woo; But I wxol passe as lightly as I can. . . ." She then advises digestives and laxatives to purge him of "choler" and of "melancolie," though she bids him remember

It is fortunate that the older currents of thought, medical and otherwise, were summarized at the very period at which they were destined to retirement by Harvey's fundamental discovery. Burton's "Anatomy of Melancholy" is a collection of all the mystic, fantastic, engaging and (to our minds) incredible procedures of an ambitious science, suggestive of the waste-products of the mind. Burton anatomizes the humors, recognizing the four primary juices

without which no living creature can be sustained; which four, though they be comprehended in the mass of the blood, yet have their several affections. . . . Blood is a hot, sweet, temperate, red humour, prepared in the meseraic veins, and made of the most temperate, parts of the chylus in the liver whose office is to nourish the whole body, to give it strength and colour, being dispersed by the veins through every part of it. And from it spirits are first begotten in the heart, which afterwards by the arteries are communicated to the other parts

and so on, with a like conjectural anatomy and acrobatic physiology for the other humors. Burton's appetite for the occult inevitably made him a believer in astrology. It is a fact that his horoscope is pictured on his tombstone, but it is presumably but a rumor that he assisted the fulfillment of the prediction of the time of his death by hanging himself. Burton's work is suggestive in view of the career of the doctrines which superceded the "temperaments" as practical exponents of character. It indicates the ready temptation for views of this nature to degenerate into vain pseudo-science, and under a common enthusiasm and prepossession to bring together in mutual tolerance diverse

that he is ''full colerick of compleccioun'' and should beware of the ''sonne in his ascensioun.'' Among the artists, Albrecht Dürer reflected the current belief that temperament was responsible for the differences of men. He urged that artists should present the features and proportions suitable to the characters of their subjects. One of his ripest productions, commonly known as ''The Four Apostles,'' also bore the title of ''The Four Temperaments.''—St. John representing the melancholic, St. Peter the phlegmatic, St. Paul the choleric, and St. Mark the sanguine.

The affiliation of ''humors'' and temperaments appears in the transferred use of the former term. The dramatic material of the age of Elizabeth with its free emphasis of personality, was typically staged in Ben Johnson's (1574–1637) ''Every Man in His Humour'' and ''Every Man Out of His Humor.'' The following is from the induction to the latter.

''To give these ignorant well-spoken days some taste of their abuse of this word humour,'' the argument proceeds: ''Why, *humour* as 'tis *ens*, we thus define it. To be a quality of air, or water, And in itself holds these two properties, Moisture, and fluxure: as, for demonstration, Pour water on this floor, 'twill wet and run: Likewise the air, forced through a horn, or trumpet, Flows instantly away, and leaves behind A kind of dew; and hence, we do conclude, That whatsoe'er hath fluxure, and humidity, As wanting power to contain itself, Is humour. So in every human body, the choler, melancholy, phlegm, and blood, By reason that they flow continually In some one part, and are not continent, Receive the name of Humours. Now thus far It may, by metaphor, apply itself Unto the general disposition: As when some one peculiar quality Doth so possess a man, that it doth draw All his affects, his spirits and his powers, In their confluctions, all to run one way, This may be truly said to be a humour.''

notions of like conjectural basis. Their common motive is a strong leaning towards the occult.

The parent view that mental traits are conditioned by bodily composition affiliated with views of similar ancestry holding that the traits were revealed in bodily signs. Such is the princple of physiognomy,—a doctrine as old as Aristotle, and older. There is the traditional story that the physiognomist Zopyrus, in reading the character of Socrates, pronounced him full of passionate tendencies, thus showing in the opinion of the disciples of Socrates, the vanity of his art. But Socrates came to his defence and confessed the reality of the impulses, which, however, he was able to resist. Aristotle's advocacy of physiognomy was not very pronounced; it may have been little more than an inclination to recognize the reflection of emotion in feature, or the coordinate growth of body and mind. But the tractate on "Physiognomy" ascribed to him served as the text to the renaissance adepts in occult lore. Thus restated, even more than in its original setting, it presents the characteristic dependence upon weak analogy in connecting specific bodily features with specific mental traits. Coarse hair, an erect body, a strong sturdy frame, broad shoulders, a robust neck, blue eyes and dark complexion, a sharp but not large brow, were together regarded as marks of the *courageous* man, while the *timid* man showed opposite characteristics. The doctrine was reenforced by such analogies as that timid animals, like the rabbit and the deer, had soft fine hair; while the courageous ones, like the lion and the wild boar, were coarse-haired.

A mental trait may have at once a natural bodily cause and a manifest or covert sign. The "humorist" may also be a physiognomist, may both account for and read human character, may prescribe for its ailments according to the one set of influences, and advise as to course and career according to the other.

There is no more instructive instance to illustrate how the old learning was reinstated with slight alteration in precept and practise than the career of Jerome Cardan (1501–1576). Esteemed by his contemporaries, shrewd and able, he was urged in one direction by his taste for science and in another by his credulity. His autobiography reveals his analytic bent as well as his strong personality. It has been said of him that for all for which his contemporaries thought him wise, we should think him mad; and for what we think him wise, they would have thought him mad. So great was his reputation that he was invited and then inveigled to travel from Naples to Scotland to treat the bishop of St. Andrews. The prelate's ailment had been described as a periodic asthma due to a distillation of the brain into the lungs, which left a "temperature and a condition too moist and too cold, and the flow of the humors coinciding with the conjunctions and oppositions of the moon." With the characteristic prestige that re-

sults from finding others in the wrong, Cardan promptly found that the Archbishop's brain was too hot and too dry. He put his distinguished patient on a cold and humid diet to resist the attraction of the brain, yet had him sleep on a pillow of dry straw or sea-weed, and had water dropped upon his shaven crown; in addition, however, he prescribed a regimen of simple food, much sleep and cold showers. The improvement that resulted—naturally ascribed to the "humoral" procedures,—added much to the glory of Cardan's reputation and the profit of his purse. This physician, learned and wise for his day, was yet the very embodiment of all things superstitious. Every trivial occurrence was an omen or potent. He cast horoscopes, wrote on all manners of cosmic influences, and espoused the rôle of a physiognomist. His distinctive contribution was an astrological physiognomy, based upon the underlying notion that the furrows or lines of the forehead *correspond* to the seven dominant celestial bodies; and that the qualities which they denoted were those connected with the powers and virtues conferred by Venus, or Jupiter, or Saturn, or Mercury, etc., in the current astrological system. Across the forehead he drew seven parallel lines, the spaces in succession dedicated to the moon and the six planets, and by the proportions and prominences of these lines he read the fortune of the subject, not hesitating in one case to predict from the grouping of these wrinkles that the owner thereof was doomed to die by hanging or drowning.

In such manner the humoral doctrine served to determine the diagnosis of disposition and ailment, while from astrology and physiognomy were drawn further indications of personal character and probable fortune. Hardly less significant for the logical temper of these pre-Harveian days were the contributions of Giovanni Baptista della Porta (1538–1615). He was impressed by the comparative physiognomy sketched in the Aristotelian writings—a field in turn indicating the strong impression that the traits of animals make upon the thought-habits of primitive people; it appears in totemic practises, as well as in animal fables from Æsop to Br'er Rabbit. The notion that stubborn persons will carry the outward sign of their obstinacy by having features in common with the face of a mule, or that foolish ones will show a like resemblance to a sheep, impresses the modern reader as a strange joke. The analogy will barely support a pleasantry or a metaphor. We are fully conscious of the metaphor of our epithets, when we call an obstinate person mulish, or a shy one sheepish, or a man of sly ways an old fox, or speak of a social lion or a wise owl or a gay butterfly; it is significant that what was once serious logic is now playful figure of speech. It is also in accord with the principle of survivals in culture that the notions made current by generations of credulous "physiognomists" continue to be circulated in the popular

manuals sold to simple folk to teach them the art of reading faces and futures.[2]

All this would be as irrelevant retrospectively as it is to our central purpose, were it not that it indicates the presence throughout the ages of a considerable body of popular lore and systematized doctrine—both saturated with flimsy analogy and engaging prepossessions—which was available for the ambitious renaissance of the interest in character and its signs in the face, through its best known apostle, Johann Caspar Lavater (1741–1801). The contrast between Lavater and such men as Cardan and Porta is as marked as that of the spirit and scope of the scientific study of their respective times. The vagaries of the sixteenth century may have stood measurably aloof from the real, if slow and uncertain, advances in the knowledge of mind and nature then maturing; but they were not wholly remote, not wholly tangential to its orbit. This was no longer true of the eighteenth century. Lavater, despite his reputation and associations and the imposing effect of his ambitious publications, failed to affect seriously or to divert the increasing stream of scientific discovery to which the early eighteenth century gave momentum. The scientific contemporaries of Lavater judged his views as critically, appreciated their wholly subjective basis in a personal predilection and their lack of objective warrant quite as justly as we of today. The contrast of attitude appears equally in the all but complete desuetude of the old persistent pseudo-sciences, astrological and others.

Lavater had nothing new to offer in principle or data or method. He was an impressionistic enthusiast setting forth conclusions with a minimum of argument, and convictions with a minimum of proof. His system was based upon subjective interpretation. His delineation of character has a direct reading of detailed mental traits by an interpretation of their equivalents or representatives in features and expression. Lavater's activities were manifold. Preacher, orator, philanthropist, political reformer, dramatist, writer of ballads, he was a conspicuous man of his times, highly regarded by his eminent contemporaries—among them Goethe, whose contribution to the *Fragments of Physiognomy* have been identified. He was quite without scientific

[2] Nothing less than a glance at the illustrations which the earlier physiognomists employed will convey an adequate impression of the vagaries of Porta and his kind. They show that what was once pictorial proof has become the artist's pastime. The material presented for amusement in Lear's "Nonsense Botany" or Wood's "Animal Analogues" is hardly more remote than that which served Porta as a serious instrument of research. Thus a portrait of Plato is printed side by side with that of a dog, and one of Vitellus Caesar is paralleled by that of a stag; and in each case some of the most deserving qualities of the animal are regarded as typical of the human embodiment. Similarly distorted illustrations show human resemblances to a lion, or a bull, or a donkey, or a deer; while the picture of a girl is ungallantly made to approach the features of a pig. These and yet more capricious ventures in animal physiognomy were incorporated into later systems, often in complete ignorance of their source.

bent or training. Yet his name was so commanding in the annals of physiognomy as to distract attention from the slightness of the foundations upon which his elaborate superstructure was raised. Indeed, the impressiveness of elaborate plates and luxurious editions, and the support of distinguished but uncritical patrons, were responsible for much of his fame. The reader who desires first-hand acquaintance with Lavater must be prepared for tedious assertion, for generalities that do not even glitter, for persistent avoidance of real issues, for the futile contention and misunderstanding of a propagandist. Of method he had little, and for the most part translated directly and by use of a dictionary of fanciful etymologies, from the language of a superficial anatomy into that of a wholly arbitrary psychology. He presented a popular, empirical grouping of feature-interpretation by virtue of a certain common-sense shrewdness, which he elevated to the dignity of a universal physiognomical sense—"those feelings which are produced at beholding certain countenances, and the conjectures concerning the qualities of the mind," which the features suggest. The extensive collection of portraits alone offset the tedium of the text. Lavater was an expert draftsman, and a diligent collector of engravings, outline drawings, and the silhouettes then in vogue. To each picture he attached a character-reading, which reflected little more than his personal impression or knowledge of the subject, to which occasionally were added special correlations of such traits as prudence, cunning, industry, caution, determination or what not, with the forehead, the eye, the nose, the mouth, the chin.

It was inevitable that the practical interest, lacking the compensations of Lavater's serious purpose, rapidly turned physiognomy into vulgar quackery. The followers of Lavater developed a craving for handy recipes by which to interpret the meaning in terms of character, of chin, forehead, eyebrows, and of the several distinctive combinations of feature, by an arbitrary or plausible system of signs. Physiognomy degenerated into a baseless and senseless empiricism. Oblique wrinkles in the forehead were held to indicate an oblique or suspicious mind; small eyebrows with long concave eyelashes were made the sign of phlegmatic melancholia; long high foreheads were advised not to contract friendships or marriages with spherical heads; such was the detailed but arbitrary correlation oracularly set forth with no more analysis or understanding of facial traits than of mental ones.

Lavater's work supplies a convincing and not too ancient example, if such be needed, of the limitations of impressionism as a basis for the study of character and of its utter futility for the purposes of a sound psychology; and that apart from the like disqualifications resulting from an ignorance of the significance of such somatic features as those which formed the basis of the system. It shows how readily an en-

thusiastic but unintelligent industry may build a monumental construction upon a hollow foundation. It illustrates as well a specific psychological fallacy: that of exaggerating the significance of traits in which we have an interest. It is the general human appeal of the face and its expression and its place in human intercourse that supplies the interest so readily abused by popular writers or commercial charlatans. It is just this realm of loose analogy and unchecked ambitious conclusions that attracts feeble minds with a taste for speculation and an inclination for the occult, the bizarre, the esoteric; such a taste, as if to appease a neglected, logical conscience, usually finds refuge in a practical semblance of verification. It is this combination of interests that supports physiognomy or phrenology, palmistry or fortune-telling, and (with an altered complexion) Christian Science or Theosophy,—in which latter examples cures or miracles instead of readings supply the realistic support.[3]

A possible redeeming feature of Lavater's work is his recognition of facial expression as worthy of study; in this he followed the leadership of the artist LeBrun. Expression is much more generic and more readily interpreted than are peculiarities of feature. In such biblical maxims as "though a wicked man constrain his countenance, the wise can distinctly discern his purpose," Lavater found a text for his exposition. Of the true meaning of expression, so far as it was possible before Darwin, he had slight understanding. His physiognomical sense conferred no physiological comprehension. Indeed, so far as he ventured into the biological territory, he reverted to the older notions, and made fish and fowl and even insects reveal their character by their effects upon the human impression. In an engraving of the heads of snakes he pointed out the reprobate qualities distinguishable in their form, the deceit of their colors, and the naturalness with which we shrink from such a countenance. The logic of physiognomy, ancient or modern, learned or ignorant, is of one kinship; it is the family associations that in time and circumstance come to be less and less respectable.

The next and last stage in the antecedents of the study of character presented a new rôle, or, it may be, an old one in a new and distinctive costume. In its practical effect and later career it resembles the system of Lavater, and invited yet greater popular abuse. Its founder was Dr. Franz Joseph Gall (1757–1828); and it achieved popularity under the name of *Phrenology*. While Lavater stood beyond the pale of the scientific activity of his day, Gall was an influential part of it. Gall's scientific service must be acknowledged even if he be held responsible for the extravagances of phrenology. The system was

[3] For the general subject I may refer to my volume: "Fact and Fable in Psychology," 1900.

extended and popularized by Dr. Johann Caspar Spurzheim (1776–1832), Gall's associate, and his successor as leader of the movement.

There are two distinct aspects to the work of Gall and Spurzheim; and it is not easy to understand or to set forth just how the connection stood in the minds of these contributors to the anatomy and physiology of the nervous system, and advocates of the locations of elaborate mental faculties by means of cranial prominences. The two orders of contributions are difficult to reconcile either in spirit or in method. The motive of "character-reading" was operative, though restricted by scientific considerations. It was forcibly made the consummation of a system quite irrelevant to the purpose. In the end, the practical temper prevailed; and phrenology allied with physiognomy, palmistry or other character-reading pretences, degenerated to the woeful state of a *declassè* pseudo-science. Its nearness to the illuminating truth served but to intensify the obscurity of its shadows. The contrast in the two spheres of the career of Gall and Spurzheim serves to explain why, as they travelled about Europe, they were by some called "a pair of vain-glorious mountebanks," and by others placed with Newton and Galileo as illustrious contributors to science. Yet the fact that phrenology called larger attention to the study of character than had any other movement gives it an important place in a retrospective view.

The impressionistic origin of his phrenological interests is thus recounted by Gall. When at school, he was struck by the fact that his schoolmates had facilities independent of instruction; that one was musical, another artistically endowed, and that this innate ability rather than application was most decisive in determining progress. He seems to have been annoyed at being surpassed by schoolmates who had a capacity for memorizing; and in an inauspicious moment he observed that these schoolmates all had prominent eyes. At the university he directed his attention to students with prominent eyes, and persuaded himself that in every case such men had exceptionally good verbal memories; and thus was the fatal correlation made. Not unlike Lavater, he trusted to his "physiognomical sense" to recognize the prominences which were to find a local habitation and a name upon the phrenological chart. At church he observed the most devout of the attendants, detected what portions of the skull were well-developed in them, and discovered the organs of *veneration*. He compared the heads of murderers and found an organ of *murder*, and similarly studied the heads of thieves and located the organ of *theft*. He had organs for the preeminent quality of each of the five senses; an organ of *tune* for the musical, and one of number for the *mathematical*. He thus accumulated a group of some twenty-four organs (which Spurzheim enlarged to thirty-five or more), and in this contribution disclosed with strange unconcern at once his self-deception and the shallowness of his psychological notions.

The common assumptions of physiognomy and phrenology (as we readily detect, though not thus obvious to the minds of their defenders) are these: (1) that there are distinct mental traits, qualities or capacities, which ordinary human intercourse and observation reveal; (2) that these are caused by (or correlated with) prominent developments of parts of the brain; (3) the critical assumption (presumably least explicit of all) that we may accept as established the relation whereby the one, the bodily feature, becomes the index of the other, the mental trait. The assumed principle of relation was plainly empirical, had no warrant in principle. The clue in all such systems was merely a sign or trade-mark displayed, in Lavater's theological view, by a beneficent Providence to indicate the virtues and vices of men. For phrenology the alleged principle was wholly different. It grew out of the subdivision of the functions of the brain. The evidence, it must be admitted, was sought by approved scientific methods. But the stupendous assumption was made that the presumption in favor of the *existence* of such specialized brain-areas included a *knowledge* of their *terms,* and that their nature was indicated by the specific differences in the observed traits of men; further, that such mental traits, giving rise to or conditioned by marked local development of brain-areas, could be detected in the corresponding prominences of the skull. So supremely unwarranted was this cumulative series of assumptions that the scientific knowledge and procedure associated with its alleged establishment failed to confer upon phrenology any more respectable status or accredited position than were accorded to the far more extravagant assumptions of physiognomy. Clearly, if the assumptions of phrenology held—itself an extravagant supposition—the study of character and temperament would be completely shaped by its conclusions. Since they are neither pertinent nor illuminating, physiological and psychological studies still have a message for the student of human nature.

The chief warrant for a further consideration of the position of Gall and Spurzheim is that their views came into direct contact with the advances in the knowledge of the nervous system, which—as will duly appear—became the requisite for true psychological progress. The central question at issue was whether the brain functioned as a whole, or whether distinct functions could be assigned to its several parts. The former position was defended by Flourens (1794–1867), who maintained that the removal of a part of the brain of a pigeon weakened the general intelligence, but that the intact portion still exercised the complete range of brain-functions, though with diminished efficiency. Gall's position required a detailed and specialized division of function. He drew attention to the fact that the mutilated pigeon, while retaining physical sight and hearing, became mentally blind to the meaning of what it was clearly able to see, and mentally deaf to the meaning of sounds; he drew attention to the important evidence sup-

plied by the association of mental symptoms with injury or disease of different portions of the brain, and noted that these were very different according to the region affected. His contentions proved to be correct in fact, in interpretation, and in method. In this controversy Gall argued physiologically, not phrenologically. In another controversy the reverse was the case. Flourens restricted his conclusions of the unity of function to the cerebrum, and confirmed the experiments on pigeons which showed that the cerebellum regulated locomotion. Gall had made the cerebellum the organ of amativeness; if it regulated the love-affairs, it could not regulate the gait. He replied first physiologically, that the experiment was defective, and the motor impairment due to concomitant injury of other parts of the brain; and then phrenologically, that if the cerebellum were the organ of locomotion, it would follow that persons with large cerebellums should be acrobats, and asked whether women (who in Gall's view possessed a small cerebellum) "walked and danced with less regularity, less art, less grace than men." Controversies of this kind were futile in view of the wholly irreconcilable positions of the advocates. In the end, the phrenological position became an obsession.

At one other point phrenology came in contact with the advances leading to modern psychology: this is in its alliance with the study of hypnotism in the career of James Braid (1795–1860). The remarkable insight of this investigator enabled him to recognize under disadvantageous conditions the true nature of this mental state as a partial disqualification of the nervous system: but it did not prevent his temporary subjection to the phrenological fallacy. He refuted the position that the hypnotic state was a histrionic deception; he demonstrated its reality, but unwittingly brought it within range of suggestion or self-deception. Later he realized the error of his earlier work: but his association with phrenology injured his reputation, and delayed the recognition of his pioneer work in a difficult field. The following suggests the course of the experiments:

> I placed a cork endwise over the organ of veneration and bound it in this position by a bandage under the chin. The patient thus hypnotized at once assumed the attitude of adoration, arose from his seat and knelt down as if engaged in prayer. On moving the cork forward, active benevolence was manifested, and on its being pushed back veneration again manifested itself.

This observation seems the very parody of science. It illustrates that prepossession, even in men of shrewd observation and ability, is disastrous to logical integrity; and further that not until the true nature of nervous functioning was established as a fundamental directive position in all psychological considerations, were false leads of this kind entirely discredited.

In view of the fact that the vogue of phrenology in the middle of the nineteenth century represents the largest collective interest in the

study of character that ever gained a temporary foothold, it seems proper to consider the nature of its pretensions and their following. Propagandists have an enviable if perilous vigor and enthusiasm—an element of reckless abandon not unrelated to the extravagances of mania in the exaggeration and self-deception which it entails. Lavater had the simpler problem of collecting drawings and engravings in imposing array to enforce the principles of physiognomy. Gall collected skulls and casts, and induced persons with marked mental peculiarities to have their heads shaven so that their replicas in plaster might be at his service. He asked that

> every kind of genius make me heir of his head. . . . Then indeed (I will answer for it with my own) we should see in ten years a splendid edifice for which at present I only collect materials.

The critical peril of false theories lies in their applications. Gall's interests seem to have remained for the most part scientific and objective; but in association with Spurzheim, whose direction of the phrenological movement largely determined its course, they took a more practical turn, and therein found their degradation. The extension of the phrenological principle to races and animals as a zoological problem appealed to Gall. He tells with ludicrous if pathetic simplicity of his baffling attempt to interpret the prominence of a part of the cranium which monkeys and women have in common. Finally,

> in a favorable disposition of mind, during the delivery of one of my lectures, I was struck with the extreme love that these animals have for their offspring. Impatient of comparing immediately the crania of male animals, in my collection, with all those of females, I requested my class to leave me, and I found, in truth, that the same difference exists between the male and female of all animals, as existed between man and woman.

Thus was the cranial localization of "love of offspring" discovered.

Phrenology similarly offered the clue to racial differences.

> The foreheads of negroes are narrow, and their musical and mathematical talents are in general very limited. The Chinese are fond of colors, and have their eyebrows much vaulted. According to Blumenbach, the heads of the Calmucks are depressed from above, but very large laterally, about the organ which gives the inclination to acquire; and this nation's propensity to steal, etc., is admitted.

It was seriously set forth that the dog, the ape and the ox do not sing because the shape of their heads shows the absence of the faculties for music; that the thrush or the nightingale had heads with developed musical faculties, and the hawk and the owl lacked these parts; that in the male nightingale or mocking bird the head was square, angular, and more prominent above the eyes, while in the female these parts were conical, thus endowing the male and not the female with the gift of song. "Observe the narrow forehead of the dog, the ape, the badger, the horse, in comparison with the square forehead of man, and you will have the solution of the problem why these animals are neither musi-

cians, nor painters, nor mathematicians." Extravagant as this may appear to our scientifically minded generation, it yet represents the more sober conclusions of men conversant with the science of the day. In the hands of system-mongers and quacks the doctrines were carried to far more capricious conclusions.

It was the practical tendency to read character and predict capacity or even career that was responsible for the rapid deterioration of phrenology. This course was set by Spurzheim, under whose influence phrenological societies were founded in England and America, and the world deluged with books, pamphlets, manuals, lessons, exhibitions, charts, plaster-casts, institutes, parlor talks and street demonstrations for the dissemination of character-reading by the bumps of the head—a movement the waves of which still beat feebly along the remote frontiers of intellectual venture. An excursion into these disorderly by-paths—suggestive of the slums of psychology—would have little profit;[4] it would but indicate that slight deviations in principle lead to the widest divergence of result. An intellectual degradation ensues as the movement descends to lower strata,—an issue not unlike the social degradation of sections of cities where questionable occupants inhabit the dwellings that sheltered the respectable citizens of other days. Though we can not hold the founders responsible for this issue, it is yet true that they prepared the way for it by their own practises. Gall and Spurzheim conducted tours in prisons and asylums, reading from the shapes of the heads of the inmates the propensity to forgery, theft, violence or lack of thrift which brought them to their fate. One prisoner showed the "organs of theft, murder, and benevolence all well developed, and, true to his organs, robbed an old woman and had the rope around her neck to strangle her, when his benevolence came to the surface," and prevented the fatality.

Such was the practical degeneration and such the fallacious principles by which phrenology attempted to oust physiology from its domain. At the time psychology was not sufficiently developed to assert its claim against the phrenological pretensions. Spurzheim had a

[4] The excursion would indeed serve to justify the general conclusion that the sporadic survival or revival of such systems as physiognomy, astrology, phrenology, palmistry, fortune-telling, dream-interpretation, etc., is due not to the appeal of their evidence, but to the persistence of the attraction of the occult as well as to the promise of practical revelation. For it is characteristic that this class of latter-day compendium upon "character" through the reading of heads, faces, hands, etc., combines and resurrects with curious ignorance of their source, with a strange insensitiveness to their mutually contradictory positions, all the varied by-paths of obscure and discredited lore which we have cursorily surveyed. Aristotle, Porta, Cardan, Lavater, Gall, Spurzheim reappear in doctrines, without assignment of source, in support of "systems" purporting to reveal the secrets of human nature for the small consideration of the purchase of the volume. The occult—representing poverty if not misery of mind—like misery, makes strange bed-fellows.

stronger psychological bent than Gall, and developed an arbitrary psychology to fit the scheme. He distinguished between the emotional and the intellectual powers, dividing the former into *propensities,* which were direct impulses to action (like the desire to live, the tendency to fall in love, destructiveness) and *sentiments* which were complex human powers (like self-esteem, hope, mirthfulness, ideality); the latter were either *perceptive* (like size, tune, time), or *reflective* (like causality and comparison). This construction was distorted and confused, but yet not so strikingly divergent from other contributions as to arouse suspicion of its forced adjustment to the alleged findings. It was these latter, apparently substantiated by anatomical evidence, that kept the system alive. In the actual procedures of proof the simple psychology of self-deception was the dominant factor. Either the trait was marked and the phrenologist readily persuaded himself that the prominence—at best slight and not clearly defined—was present; or in the presence of a marked "bump," he was readily convinced that the required trait—as a rule a matter of uncertain and variable judgment—was conspicuous. As a contribution to the temptation that allegiance to theory offers to the self-deception in the determination of fact, the retrospective view of the subject has permanent value. Prepossession, though unrecognized by the phrenologists, is likewise a quality of human nature, with an interesting psychology of its own.[5]

At this juncture we turn from the antecedents to the more direct line of descent of modern psychology. The successive claimants to the domain of "character and temperament" may be said to have momentarily triumphed and passed away, without accredited issue. The new sovereignty represents a very different allegiance. It shares

[5] It is characteristic of the wave-like oscillations of movements of this kind that in periods after the desertion of the position by the scientific world, an occasional reaction appears and gains a considerable adherence. An Ethological Society, which publishes the *Ethological Journal*, was founded in 1903 and attempts to reinstate the phrenological position, though in a wholly modified form and with an attempt at reconciliation with the established localization of function in the brain; the latter is in a legitimate sense the new and true phrenology. There is no reason, except the historical one (which, however, is adequate), for giving the term phrenology any less respectable status than that of psychology itself. It is clear that the doctrine of the localization of function in the cortex of the brain represents a chapter in the development of physiology, which replaces the series of conjectural and extravagant views that belong to the antecedents of our subject. It should not be inferred that the Ethological Society is wholly devoted to this reinstatement of phrenology; it considers the entire range of topics bearing upon character and temperament, but presents a leaning towards the impressionistic and obscure interpretations. It may be added that so distinguished a contributor to the principles of modern evolution as Alfred Russel Wallace believed that the neglect of phrenology was one of the intellectual crimes of the nineteenth century, and maintained that this aspect of physiological and psychological research is central in its promise for

in the common heritage of modern science. The notable extension of knowledge through experiment is ever paralleled by a development of logical method and critical interpretation, as well as by an extension of technical resources. To this general movement psychology owes its present status, and shares in its benefits. It finds a concrete expression in the psychological laboratory, and a yet more comprehensive one in the transformation of the entire range of accredited problems, and the introduction of new realms of inquiry. The technical advance in the knowledge and control of physical, biological and psychological forces characterizes the modern world of science. These divisions of intellectual enterprise, though differently directed, are mutually corroborative. They progress by the application of a common logic. *Standards of evidence, extension of data,* and *the basis of interpretation* develop together. Jointly they determine the spirit of modern science, from which psychology along with the rest of the sciences, receives its directive bent and the temper of its pursuit. A coordinate factor is the dominance of an expanding practical philosophy—a worldly wisdom born of a larger experience in social, political and economic relations. It is expressed in the standards of intercourse and living, and more particularly in the cosmopolitan outlook, reflecting the insight into the determination of events and careers as of the qualities of men shaped by, and shaping them. This influence extends to literature, philosophy and the arts of life; it provides the background against which the technical pursuits are projected, from which they emerge.

The establishment of the principles and the body of knowledge determining the present study of character and temperament is the convergent product of a complex development; it forms an integral part of the general advance for which the nineteenth century—the culmination setting in with marked acceleration in the second half thereof—is notable. Our purpose will be served by considering broadly the contributory branches of investigation to which psychology is particularly indebted. Among these the establishment of the relation between body and mind is clearly central. Equally fundamental is the interpretation of the vital processes and provisions through a unifying and illuminating principle. This was supplied by the master-key of evolution, and at once rationalized and vitalized the conception of origins and transformations of natural processes and products—including the manifestations and endowments of the mental nature. Interpretation became possible in a convincing language—quieting the babel of tongues. Both of these guiding principles—the latter particularly—were revolutionary in their influence, not primarily by the new exten-

the regulation of mental affairs in the future. The attempts to restate certain aspects of the phrenological position in modern form should be mentioned. They undertake a "Revival of Phrenology" and are represented by Hollander "The Mental Functions of the Brain" (1901).

sion of knowledge and interest (which was in the main a consequence of the new insight), but by the introduction of a new interpretation. Familiar facts were given a distinctive and a richer meaning. The perspective of significance was notably altered. This momentous reconstruction of the biological realm indicates in a few words the decisive factors that made modern psychology possible. The brevity of the record should not diminish the appreciation of its vital importance.

The development of the knowledge of nervous function has a venerable history. The recognition of sensation and movement in relation to the nerves occurs sporadically and irregularly in Greek, Roman and medieval medicine, at times with a shrewd interpretation of symptoms. It seems never to have been made a leading principle, but was held in detachment from the general notions in terms of which conclusions were stated. Hippocrates, Galen and their followers occasionally record observations in which a limited loss of movement (paralysis) and loss of sensation (anesthesia) were referred to interference with the action of certain nerve-trunks. Such observations remained casual and incidental. The usual explanation of the bodily accompaniments of mental action were given in terms of the flow of the "vital" spirits, with the veins (supposed to contain air) as the true channels of the flow that determined sensation; while the ventricles (literally breathing spaces—actually the channels for the cerebro-spinal fluid) were assigned the central part in the vital service. Vesalius, founder of modern anatomy, knew by experiment apparently as well as through inference from observation, that section of the nerves abolished muscular control and that the loss of the medulla deprived an animal of sensation and movement. He contested the notion that faculties like memory could reside in such spaces as the ventricles of the brain. But such views were heretical to the scriptural authority of Galen and Hippocrates, and were timidly expressed and pursued. As a type of conception matured under philosophical pursuits critically maintained and in relation to the science of the day, may be cited the view of Descartes. He looked upon the nervous system as a mechanical automaton—somewhat after the manner of an elaborate and fantastic "playing" fountain, whose ingenious streams turned windmills and started miniature water-spouts. The nerves were conceived as tubes for the flow of "animal spirits," or of some similar agency, with the pineal gland in the center of the system as a controlling valve directing the flow—the flow according to the course resulting in one kind or another of mental process. Even Willis, despite his insight into the structure and function of the brain and the complex provisions for its circulatory system, could speak of it as an instrument which the "soul inhabits and adorns with its presence." He conceived the blood as a vital flame, through which products of combustion arose and in turn gave rise to mental processes. Each variety of physical change which

the physiologists and chemists discovered in the laboratory of the body —such as distillation and absorption, or fermentation and evaporation, along with the older conception of animal spirits (the latter term used confusedly at once in a psychological and a chemical sense; hence "spirits" of ammonia, turpentine, etc.) were in turn called upon to account for the transformations responsible for the elementary mental processes.

There is nothing notably distinctive in the successive formulations of "nervous" function from the days of Harvey, who gave the directive impetus to physiological conceptions, to those of Haller, who first applied them with marked success to develop the conception of nervous responsiveness (irritability) through specific adaptation of the organism to the stimulus. Haller was not free from the speculative vagaries of his predecessors: yet he thought of the problem of the physiological basis of mental processes consistently and clearly. His contributions so decidedly advanced the conception of nervous function that it was relatively easy to make the transition to the true interpretation given first by a group of physiologists in the early nineteenth century (Marshall Hall, Charles Bell, Majendi) and culminating in the actual measurement of the rate of nervous impulse by Helmholtz in 1850. The position of Haller is notable not only for the general correctness of his conclusions and the experimental evidence upon which they were based, but equally because he separated so clearly what was conjectural from what was established. In a number of cases the task of his successors was merely to follow his lead and transform conjecture into proof.[6]

[6] An admirable statement of the development of knowledge of the nervous system is found in Sir Michael Foster's "Lectures on the History of Physiology" (1901), Chapter X. G. Stanley Hall's "History of Reflex Action" (*American Journal of Psychology*, January, 1896) should also be consulted. Andrew D. White's "History of the Warfare of Science and Theology" (1896) provides an illuminating commentary upon the movement of thought through which the present subject reached its modern stage. Of the histories of psychology that of Dessoir (1912) contains the most distinctive appreciation of the "character and temperament" movement. Of the more recent studies the most noteworthy are: A. Levy, "Psychologie du Caractère" (1896); Malapert, "Temperament et Caractère" (1902), "Les elements du Caractère" (1906); Alfred Fouillé, "Temperament et Caractère, etc."; Paulhan, "Les Caractères" (1894); Th. Ribery, "Essai de Classification Naturel des Caractères" (1902); L. Klages, "Prinzipien der Characterologie" (1911); Sternberg, "Characterologie als Wissenschaft" (1907); C. J. Whitby, "The Logic of Human Character." These works are by no means of comparable value, scope or treatment; nor does any one of them interpret accurately the message of modern psychology upon the subject. The literature bearing upon the training of character is large, but not pertinent to the present survey. Of books of other purpose with important bearing upon the subject may be mentioned MacDougall, "Social Psychology" (1908) and Wallas, "The Great Society" (1914). A peculiarly notable volume is A. F. Shand, "The Foundations of Character" (1914). No reference is made in the retrospective view or in the recent literature to the several modern attempts to

This account of one strand in the network of data indispensable to the establishment of a psychological point of view is presumably typical of parallel movements. It indicates how recent are the steps of direct bearing upon present-day problems, and in so far justifies the slight consideration (in the present connection) of the remoter and more fragmentary historical antecedents. It will also make it easy to understand how readily in the absence of an accredited and established view of the bodily correlates of mental action, the ambitious innovations as well as the traditional survivals of beliefs could gain a foothold. This is true in part of even so late a propagandum as that of Lavater—which in large measure was operative before the day of the most decisive discoveries—and to the careers of Gall and Spurzheim, whose contributions in part came after them. The spirit of nineteenth-century science was not then sufficiently disseminated to make obvious the irrelevancy of such pretensions as phrenology, nor indeed to offer a satisfactory consideration of the problems which that system professed to solve.

In the collateral ancestry of "character and temperament" the anthropological attitude occupies an important place,—in a new sense making mankind the proper study of man. It forms part of the broadening outlook upon the constitution of nature in general and human nature in particular, that characterizes modern thinking. It doubtless has a relation to the closer study of the political struggles of nations and to economic expansion, though the relation is not intimate. It aimed at a philosophical interpretation of the structure and motive sources of human society and institutions. The anthropological interest extended to the characteristics of the social groups, particularly of races and peoples in different stages of development and under the sway of distinctive cultures. The enlargement of outlook resulted from the spirit of exploration and inquiry, which brought knowledge of peoples and habitations and other systems of culture, and in another direction extended the reconstruction of the past of man. A similar enterprise resurveyed the story of the intellectual past and traced the slow control of the forces of nature through invention, and the equally laborious attainment of a social control through the organizations of men. The larger intercourse with varieties of mankind together with the broader interpretation of the forces responsible for the development resulting from the same spirit of exploration and inquiry that led to the technical scientific advances, brought with it a more thorough knowledge of the diversity of men and civilizations, and traced in the latter

develop "readings of character" from signs and systems of appearance or expression. The best-known of these is palmistry and graphology. That handwriting has a modest place as an expression of the neuro-muscular function is an admission that in no sense qualifies it to serve as an index to "Character." That a few students of handwriting have appreciated the physiological and psychological aspects of their findings is to be recorded.

the issues of the interplay of desires, capacities and beliefs, by which to interpret our own and (with allowance) foreign natures. Culture acquired a more real and a richer meaning as a psychological product, and therewith conferred a new insight and a new obligation upon the psychologist. The diversity of men was thus related to their divergent solutions of the problem of shaping their lives to satisfy needs, impulses and desires; and the environment, so largely a psychological one, acquired its full significance. The study of human nature embraced more than that of one time and region and status. The still more recent and independent emphasis of the sociological aspects of life is in the larger view an issue of the anthropological interpretation, but is yet more characteristic of the attitude now dominant, and properly called modern. The psychology of the social relations was thereby made an integral part of the study of human character.

Two further aspects of the qualities of which character and temperament form the realistic composite, are the genetic aspect, and the abnormal—the pathological aspect. The growth of traits is an essential part of their nature. It implies a reference to the setting in which they operate, to which they are adapted, by which they have been shaped. It implies equally the reference to the vital course, the maturing unfoldment of native endowment, which makes the biological aspect of human nature the most comprehensive and the most elemental. Within this compass the determination of hereditary forces and their mode of operation assumes a special importance. The traits forming the composite of Character and Temperament are part of the biological inheritance, are the issues of forces whose fundamental significance is the biological one. Accordingly (despite or in addition to our more detailed interests in other aspects) they must reflect and conserve the allegiance to this underlying relation. More specifically, the genetic aspect differentiates the outlines of the stages of growth; in its terms are described the orbit of the psychological cycle. It yields the psychology of infancy, of adolescence, of maturity, of senescence, and presents the course of the included qualities in mutual illumination. The genetic argument emphasizes a progressive environment and a progressive purpose: it enlarges the scope of adaptation, and it interprets the impetus and goal of varying interests and endeavors. It was never absent from the accredited psychology of human nature, but in the modern view it assumes an explicitness and a directive position that constitutes it a notable factor among the available resources. It has powerfully affected our entire view of human qualities, has extended our data and enriched their interpretation.

A parallel statement may be made of the argument from the decay, the faulty development, the inherent liability to perversion, of natural qualities, which are responsible for the pathological, the abnormal, the divergent aspects thereof. Useful adaptation, due proportion, tem-

pered blending, related emphasis of traits stand as the normal issue; the divergence or failure thereof becomes the abnormal. The abnormal in excess or defect takes its place as an instrument of analysis and an enlargement of data. It is a distinctively modern resource, particularly in the refinement of its application.

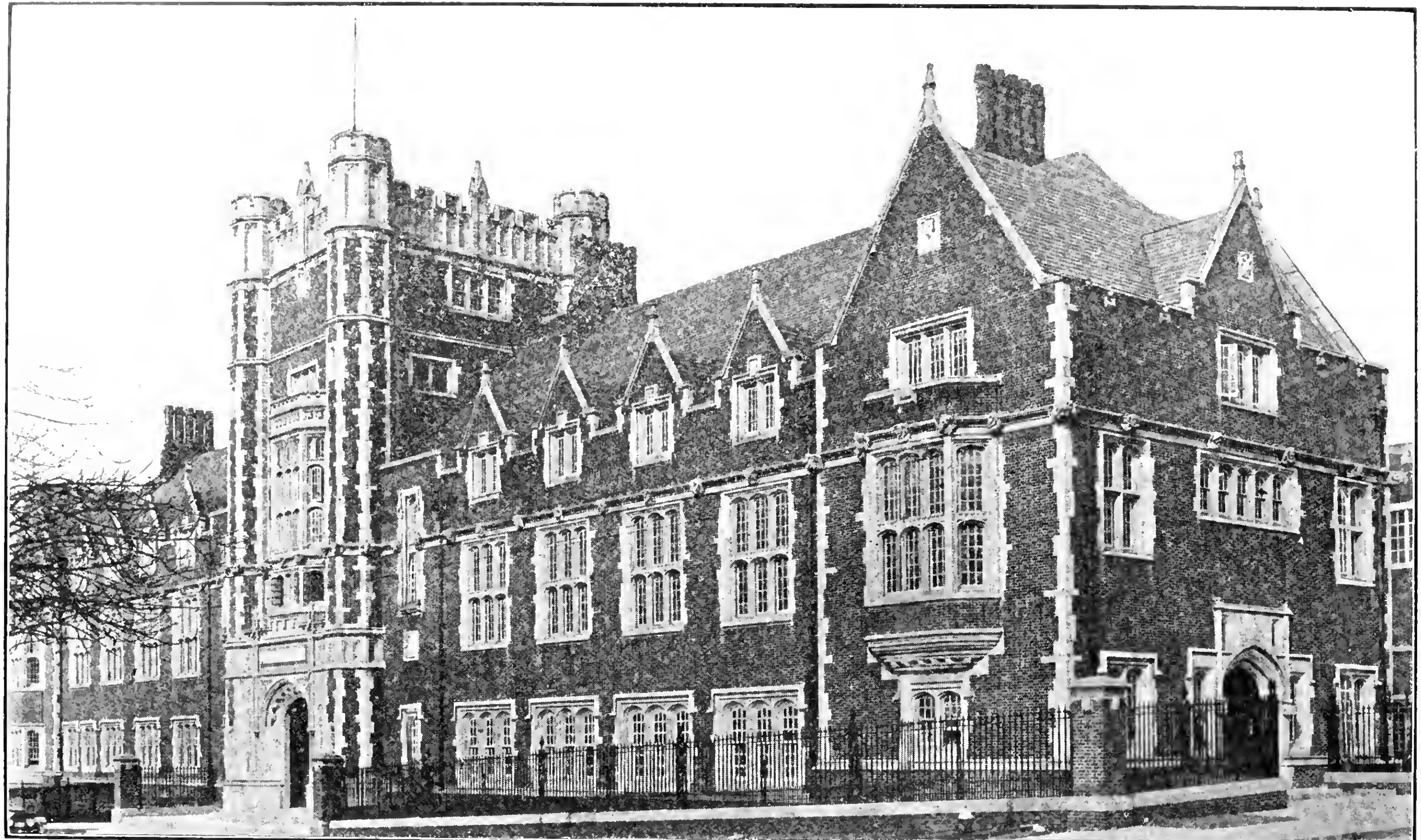
It is in such general terms that the line of descent of the present psychological interpretation of human endowment proceeds. The more specific history of the attempts to formulate the resultant positions is brief. The classic chapter (Book VII., Chapter V.) "Of Ethology, or the Science of the Formation of Character," in John Stuart Mill's "System of Logic" (1843), though a programme rather than a contribution, still has significance. The project was undertaken by Alexander Bain in a volume bearing the title "On the Study of Character" (1861). Though Bain wrote at a time when psychology had made rapid advances and the vagaries of phrenology had been retired to their proper place, he devoted a considerable portion of his book to a refutation of the phrenological position. He thus conferred an undeserved dignity upon these findings and gave his constructive views an unfortunate setting. The subject was independently pursued by a group of writers (mainly in France and Italy), whose contributions in part belong to the living literature of the subject.[7]

It remains to touch upon the collateral streams of interest which in modern times maintained the study in one or another aspect, thus bridging the gap between the old and the new learning. Among these is the attempt, never wholly absent in practical ages, to guide training, to indicate on the basis of an analysis of character the promise of youth, and the direction of vocation—all in the spirit of a worldly wisdom. As an example of the earlier period, the work of the Spaniard, Huarte (1530–1592) "The Trial of Wits," may be cited, since it seems to have attained a large circulation, was translated into several languages (the English edition appearing in 1698), and the German so late as 1752 by the great Lessing (1729–1781). There were other writings of similar import both before and after Huarte. It is, however, difficult to estimate their influence in the current of thought destined to be redirected in a more scientific analytic interest. There is no hesitation, however, in recognizing in the works of Kant (1724–1804) a dominant influence in the rehabilitation of the subject. This appears not alone in his recognition of the claims of the practical reason, but notably in his "Anthropology" (1798). Indeed Kant's use of this term corresponds more closely to a study of the individual differences of men—which the problems of character and temperament consider—than to the content of the science which now bears that name. Special attention should also be directed to his "Observations on the Sense of the Beautiful and Sublime," in which is given in a modern vein a detailed

[7] See previous note.

analysis in the field of the emotions, with excursions into the comparative psychology of the sexes and of nations. It shows the shrewd analyst in an engaging light. Of the writers affected by the Kantian position, who realized that the study of character offered a great field for the applications at once of philosophy, of anthropology and of education, Julius Bahnsen is the most representative. His work on "Charakterologie" (1867) both in method and scope represents the attempt to reach general and practical conclusions in the spirit of the early nineteenth century. It does not incorporate the views of the bases or sources of character which were even then available and which were represented by a group of German physiologists, such as Johannes Müller (1801–1858), K. F. Burdach (1776–1847) (and in a different temper Lotze and K. G. Carus)—who as sympathetic with the life of the practitioner brought to their philosophical generalizations the spirit of exact knowledge.

The establishment of modern psychology is the culmination of many interests: in no aspect is this historical development more significant than in regard to the sources of the view of the qualities of men as applied in modern life. The attempt to short-circuit the route from theory to practise, from understanding to application, has always ended disastrously. The correctness of the foundations determines the strength of the edifice. The study of the nervous system and the recognition of the subjection of all human traits to an evolutionary process laid the foundations. The sociological expressions of human qualities were related to their biological significance. The competition of human qualities received a psychological interpretation. Narrow views were avoided by considering the varieties of human culture and expression. Institutions, though dominantly an environmental product, became significant as embodiments of psychological needs and their satisfaction. Vocations became directions of special endowments. National characteristics were similarly interpreted. Education was seen to be a transformation of original trends as well as a direct preparation for the situations of an artificial life. Human nature was at once the material upon which all desired ends had to build, while yet to be remodeled for such cherished purposes. A closer knowledge of the mode of working of the human endowment resulted from the experimental study of the underlying processes of the mind. Language, art, science, customs, social institutions, political relations, reflected the spirit of a collective mind, though often articulate through the original contributions of favored individuals. With this combined equipment the psychologist of to-day proceeds to the interpretation of the traits of men summarized in the study of character and temperament. The antecedents of this view form a notable chapter in the development of the human mind, in the story of the control of the psychic forces of which culture is a record.



The Thomas W. Evans Museum and Dental Institute.

THE PROGRESS OF SCIENCE

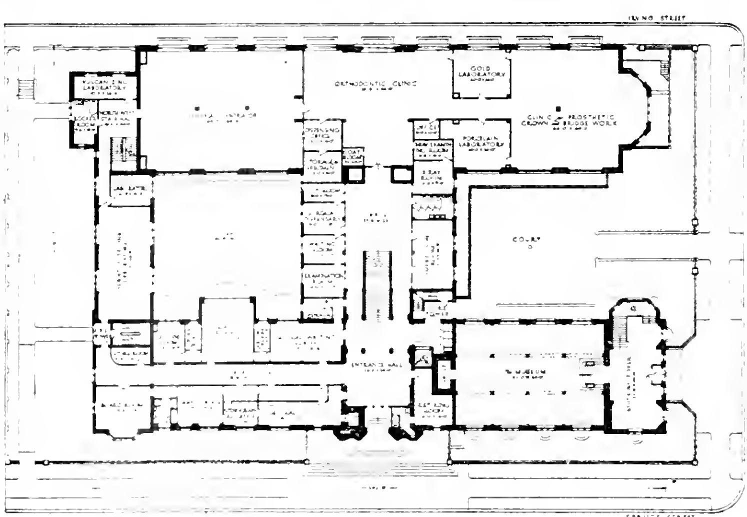
THE THOMAS W. EVANS MUSEUM AND DENTAL INSTITUTE

THE recent dedication of the Evans Dental Institute School of Dentistry, University of Pennsylvania, marks an epoch in the history of dental education as it formally opens the largest and best equipped plant in the world, devoted exclusively to the teaching of dental science. The standard which the Evans Institute will be able to maintain will be of the very highest type, and will result in carrying out, in the most effective manner possible, the wishes of the Philadelphia philanthropist, by whose name the institute and school will hereafter be known.

The new building is in the Tudor style of architecture which prevailed in the time of Henry VIII. and might be described as collegiate gothic, being in keeping with other late buildings, constructed of Indiana limestone and hard-burnt brick. It was designed by John T. Windrim. Ground was broken on September 24, 1912, and the corner-stone was laid on May 3, 1913. The building has a frontage on Spruce Street of 242 feet, and a depth to Irving Street along Fortieth Street of 161 feet. It is built in the form of the letter H and has three stories over a high basement. The benefaction of Dr. Evans includes this building with its equipment and a substantial endowment fund.

Among the interesting features of the building are the square tower and the Evans Museum. The tower, which is at the main entrance at the center of the Spruce Street wing, is thirty-eight feet square, rising to eighty-four feet. In the center of the tower, beginning at the second story and reaching almost to the top of the third floor, is a large window, which lights the library on the second floor.

The Evans Museum occupies the east half of the Spruce Street wing, and is as nearly fire and burglar proof as modern science can make it. This houses the priceless Evans collection.



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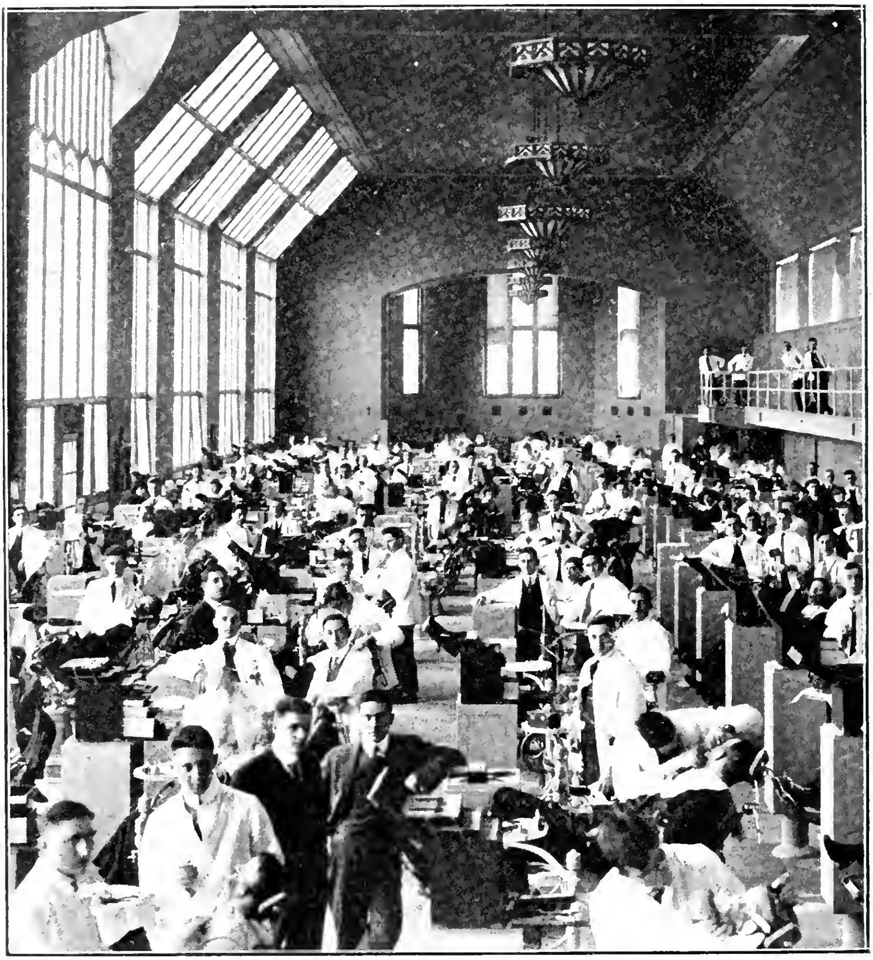


THE OPERATIVE CLINIC HALL.

In the west end of the Spruce Street wing are the offices of the dean of the institution, and the board-room. The rest of the ground floor is divided into class-rooms and laboratories, the entire north wing being devoted to this purpose. To the right and left of the monumental hallway, which extends from the roof to the first floor, are rooms for various phases of clinical dental service, radiography, photography, instructors' rooms, etc., and a model dental office.

Another of the imposing features of the building is the large operative clinic hall in the north wing on the second floor. This occupies th entire wing on Irving Street and is two hundred feet long by forty-eight feet wide. This clinic room is thirty feet high, with a glass wall on the north side; the roof for a distance of about ten feet is also glass, giving all the daylight possible. The floor is covered with battleship linoleum. A gallery on the south side contains the lockers. The room is fur nished with 135 chairs, each chair equipped with electric service for power and light. There is also gas, compressed air and water service to each chair.

In the south wing, on the second floor, is the library, which extends up through the third floor, with galleries on each side. From the library, on the east end, extends the main lecture hall, eighty-seven by forty-three feet, and on the west end are two smaller lecture rooms. One of the principal objects of the institute will be the encouragement of research work, and a number of rooms for that purpose are on the second floor.

The main stairway ends at the second floor, in a large hall open to the roof. The side walls of this hallway are in pinkish gray stone, and the ceiling is of metal and plaster, formed and painted to represent the carved wooden ceilings of the Tudor period. Large laboratories, with lighting similar to that in the clinic, occupy the south wing on the third floor, and other rooms for research work and post-graduate instruction in the western end. In the basement are locker rooms for the students, laboratories for mechanical dentistry, the metallurgical laboratories, and laboratories and lecture rooms for first-year men, and a restaurant for students and faculty. The power house adjoins the building on the north. This contains two boilers with a capacity of 400 horse power. The engines and electric generators are capable of producing 240 kilowatts, and will furnish power for the lighting and heating, as well as for the laboratories and the chairs in the clinic.

The School of Dentistry at the university was organized in 1878, being the third dental school in America to be connected with a university. The dental school is the most cosmopolitan of the departments of the university, its students usually representing about twenty-five foreign countries and almost every state of the union. It now has a teaching staff of eighty-three professors and instructors, and six hundred and sixty-five students. The school operates a free dispensary, in which about 40,000 cases are treated annually.

When the school was first organized, it occupied for a short time a room in the old Medical Hall (now Logan Hall), and subsequently quarters in the Hare Laboratory of Chemistry at Thirty-sixth and Spruce Streets, but in 1896 it removed to a building especially constructed for it. There its growth has been remarkable, and it has long since outgrown its "new" quarters. It now enters into its fourth home, The Thomas W. Evans Dental Institute.

By concurrent action of the trustees of The Thomas W. Evans Museum and Institute Society and the University of Pennsylvania an agreement between them was executed in 1912, by the provisions of which a cooperative affiliation of the two institutions was consummated so that the resources of both have been utilized in the creation of a dental school to be carried on "as such institutions of learning are now conducted in Philadelphia, and not inferior to any already established," as provided for in the will of the late Dr. Thomas W. Evans, an eminent scientific man and dentist who practised in Europe, but who was born in Philadelphia, and lived in a house which stood where the building bearing his name now stands, which houses the affiliated institutions, at the northwest corner of Fortieth and Spruce Streets.

LOCOMOTIVES AND STEAM ENGINES IN THE NATIONAL MUSEUM

PROBABLY no museum collection better illustrates the development of the steam engine, particularly the locomotive, than the exhibit of the U. S. National Museum. It possesses a model of a very early machine designed by Sir Isaac Newton in 1680, which was propelled by a jet of steam projected backward against the air, and a model of Denis Papin's invention of about the same time. The investigations of Savery, and Papin, and the successful experimental engines of Thomas Newcomen in 1705, with his piston and cylinder soon followed. Newcomen's ideas were improved by James Watt in 1769, who also introduced the high-pressure

engines, the condenser, and later the double-acting engine. The development of the engine was advanced by Cugnot, Evans, Hornblower and Murdoch; a model of the latter's engine is on display in the museum.

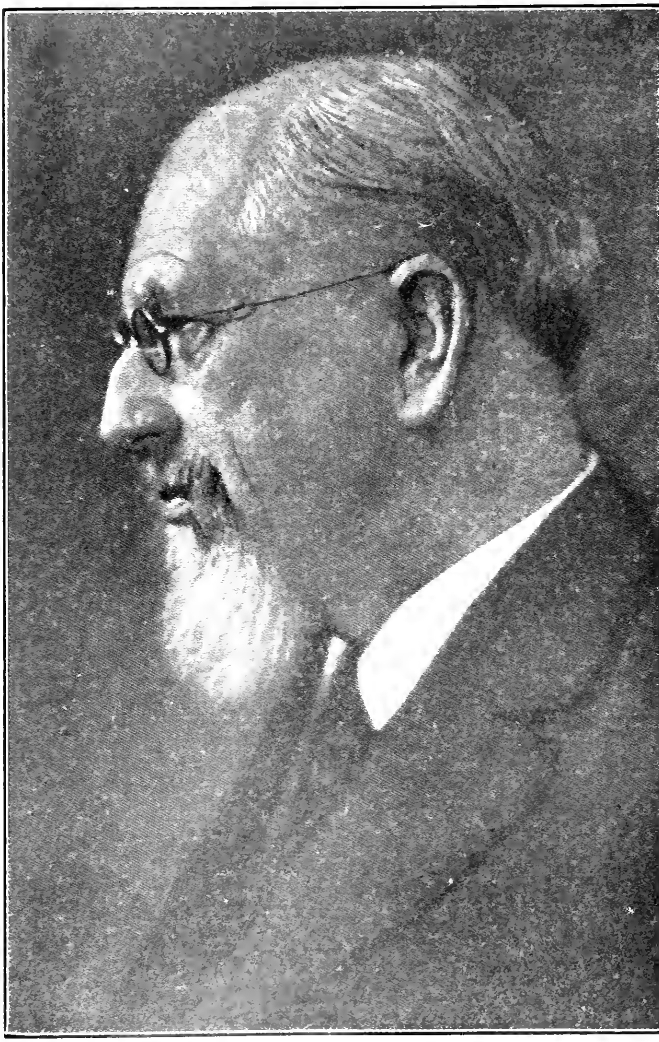
Richard Trevithick made the first engine to run on rails in 1803. It has been claimed that he copied the stationary engine built in 1800 by Oliver Evans, an American, which was later attached with wheels to a scow and propelled it by steam through the streets of Philadelphia in 1804. This curious creation called the "Oruktor Amphibolis," was the first motor car to run on American soil.

A model of Trevithick's engine is to be seen in the National Museum, as is also the model of the engine employed by John Stevens in 1825, and his original tubular boiler. Other models illustrate nearly all the types which began to put in their appearance soon after 1828, when the "Stourbridge Lion" was built in England and shipped to America, where it was the first engine to run on full-sized rails. The museum possesses not only the model of this historic engine, but the original engine itself. The other original full-sized locomotive to be seen in the museum, is the "John Bull," built by George Stephenson and Sons, of England, and shipped to America for use in 1831 on the Camden and Amboy Railroad. This old relic of early railroading in America made a round trip under its own steam in 1893 from New York to Chicago, where it was exhibited at the Worlds Columbian Exposition. Among the models of early and historic locomotives are: George Stephenson's "Rocket" built in 1829; The B. & O. engine "Tom Thumb," built by Peter Cooper in 1829; the grasshopper type engine, "Arabian" of 1831; the "Best Friend" used in 1830–31; Baldwin's "Old Ironsides" constructed in 1832; the "Sandusky" built in 1837, and models of engines made by Asa Whitney, in 1840, and G. A. Nicholls in 1848. Besides the two locomotives and the numerous engine models, there are in the exhibit, coach and car models, sections of rails, spikes, wheels and models and parts of valves, pistons and other early patented accessories pertaining to locomotives and railroads, all of which go far toward completing an absorbing chapter of graphic history in connection with this interesting and important commercial development.

THE IMPROVEMENT OF ACOUSTICAL CONDITIONS

At Western Reserve University the ceiling and walls of the Amasa Stone Memorial Chapel have been treated for the purpose of perfecting the acoustics of the building. The chapel is one of the most beautiful Gothic churches designed by Henry Vaughan, of Boston. Unfortunately, however, as in many lofty structures, the acoustics have not been satisfactory. A series of experiments with sounding boards was made by Professor Frank P. Whitman, of the department of physics of the university, in the hope of improving conditions. Careful data obtained by Professor Whitman showed that the effect of the sounding boards was almost negligible. Acoustical experts were called upon to study the problem.

The difficulty experienced in the auditorium was found to be what is technically known as reverberation, in excessive amount. Owing to the size of the building and the consequent long distance between reflections of the sound from one surface to another, and also owing to the hard and unyielding building materials which cause only a small percentage of the sound to be absorbed at each reflection, the result was that every sound generated within the chapel persisted for a number of seconds after the source itself had ceased, thus causing great blurring and confusion in spoken addresses, owing to the overlapping of the sounds of consecutive syllables. This phenomenon has been the subject of extensive study by Professor W. C. Sabine, of Harvard



WILLIAM HEALEY DALL,

whose fifty years of service to science was commemorated by a banquet at Washington on April 21, when distinguished speakers gave appreciations of Dr. Dall, the Alaska pioneer, the anthropologist, the coast pilot, the malacologist, the paleontologist, the zoologist, the nomenclaterist, the poet and the man.

University, who has established the laws governing it in a series of researches conducted during the past fifteen years.

The correction of the chapel was engineered by Mr. C. M. Swan, acoustical expert of New York City, and associated with Professor Sabine. Layers of highly sound-absorptive felt were placed on a portion of the interior surfaces of the chapel, the thickness, area and location being governed by the requirements of the problem. The careful consideration of these factors is said to be essential to a successful outcome to the work, as accurate figuring must be done to produce a mean condition satisfactory both for music and speaking. An over-doing of the treatment would produce a "dead" condition and a diminution of the loudness of the sound, which would prove as objectionable in its way as the original condition of general reverberation.

The treatment was installed by a local firm of contractors under Mr. Swan's direction, and was covered with a protective and concealing membrane in such a way that the untrained eye would not perceive the change. Even the most unskilled ear, however, is quick to perceive the change which has been brought about in favor of normal conditions of hearing. It is said that the improvement in the acoustics has been remarkable and that a degree of comfort is now experienced in the use of the chapel which has never before been possible.

SCIENTIFIC ITEMS

We record with regret the deaths of Dr. Jay W. Seaver, for twenty-five years director of the Yale gymnasium and professor of hygiene in the university; of William Harlow Reed, curator of the museum and instructor of geology in the University of Wyoming; of Mr. Richard Lydekker, F.R.S., known for his work and writings on natural science; of Dr. Arthur Sheriden Lea, formerly university lecturer at Cambridge on physiological chemistry, and of Professor Friedrich Loeffler, the distinguished pathologist, who in 1884 discovered the diphtheria bacillus.

Members of the National Academy of Sciences have been elected as follows: Dr. Charles Greeley Abbot, director of the astrophysical laboratory of the Smithsonian Institution; Dr. W. E. Castle, professor of zoology, Harvard University; Dr. G. Stanley Hall, president of Clark University and professor of psychology; Dr. Frank R. Lillie, professor of embryology, University of Chicago; Dr. Graham Lusk, professor of physiology, Cornell Medical School; Dr. Robert A. Millikan, professor of physics, University of Chicago; Dr. Alexander Smith, professor of chemistry, Columbia University; Dr. Victor C. Vaughan, professor of hygiene and physiological chemistry, University of Michigan; Dr. H. S. White, professor of mathematics, Vassar College; Dr. S. W. Williston, professor of paleontology, University of Chicago.

Mr. Andrew Carnegie's gifts to the Carnegie Institute and Institute of Technology have now reached a total of $27,000,000, his latest contribution announced at Founder's Day, on April 29, being $2,700,000. Of this latter amount $1,200,000 is for new buildings and $1,500,000 for endowment.—The campaign to raise $1,385,000 for the Stevens Institute of Technology in Hoboken, N. J., has been successfully concluded. The entire indebtedness of the college, amounting to $385,000 has been cancelled, leaving $1,000,000 to be used for the erection of new buildings and for endowment.

INDEX

NAMES OF CONTRIBUTORS ARE PRINTED IN SMALL CAPITALS

13